KEKAHA SUGAR COMPANY, SUGAR MILL BUILDING HAER HI-83
8315 Kekaha Road *HI-83*
Kekaha
Kauai County
Hawaii

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

FIELD RECORDS

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
1849 C Street NW
Washington, DC 20240-0001

HISTORIC AMERICAN ENGINEERING RECORD

# KEKAHA SUGAR COMPANY SUGAR MILL BUILDING

HAER No. HI-83

| | |
|---|---|
| Location: | 8315 Kekaha Road<br>Kekaha<br>County of Kauai<br>Hawaii<br><br>USGS 7.5 minute series topographic map,<br>Kekaha, HI 1983<br>Universal Transverse Mercator (UTM) coordinates:<br>04.431600.2429880 |
| Date of Construction: | 1935-1955 |
| Engineers & Builders: | Kekaha Sugar Company |
| Present Owner: | Kekaha MS, LLC |
| Present Occupant: | Vacant |
| Present Use: | Abandoned |
| Significance: | The Kekaha Sugar Company Sugar Mill is associated with the development and history of sugar in Hawaii. It is a good example of a twentieth century sugar mill in Hawaii, which reflects its period in its machinery, materials, method of construction, and design. |
| Report Prepared by: | Don J. Hibbard and Wendy Wichman<br>Architectural Historians<br>Mason Architects, Inc.<br>119 Merchant Street, Suite 501<br>Honolulu, HI 96813 |
| Date: | December 2008 |

## HISTORICAL CONTEXT

### Sugar in Hawaii

Although the growing of sugar cane in Hawaii has a long history, dating back to the period of early migration when Polynesians introduced sugar cane to the islands, Hawaii arrived late upon the world scene for the commercial production of sugar. The earliest known attempt to mill sugar in Hawaii was undertaken in 1802, by a Chinese man on Lanai whose name has been lost to the annals of time. His endeavor was short lived, as were a number of other early nineteenth century efforts. The first venture to establish itself on a long term basis was Ladd & Company at Koloa on the island of Kauai, which commenced operations in 1835. However, by the time Ladd & Company exported its first two tons of raw sugar in 1837, the sugar industry already had been established in the West Indies and South America for over a century, and Cuba alone was producing more than one hundred thousand tons of raw sugar a year. By 1850 world production of cane sugar approached one million tons, and France and Germany were beginning to produce beet sugar.

Despite Hawaii's late entry into sugar's global market place, entrepreneurs in the islands were encouraged by the moderate success of Ladd & Company and in the ensuing years several other plantations were started. These endeavors were relatively small, autonomous operations. The nascent industry was bolstered momentarily during the Civil War by increased demands resulting from the Union being cut off from the south's supply. However, with the conclusion of the Civil War, Hawaii's sugar industry struggled to survive. In 1872 there were thirty-two plantations in existence, but four years later there were only twenty-six, and the industry did not gain a firm economic footing in Hawaii until the passage of the Reciprocity Treaty in 1876, which allowed Hawaii sugar to enter the United States duty free. This exemption gave Hawaii sugar producers an additional profit of two cents a pound. In 1875 Hawaii produced 11,154 tons of cane sugar, less than one percent of the world's output; a dozen years after the signing of the treaty, the islands exported 100,000 tons of sugar. By 1898, this tonnage had risen to 200,667 or over seven percent of the global supply.

Although not the largest producer of sugar in the world, by 1897 Hawaii was the most efficient producer in the world, with an average yield of over four tons per acre, as compared to its chief competitors, Cuba at two tons per acre and Louisiana at one ton per acre. By the 1970s Hawaii's plantations averaged over ten tons per acre. Much of this improvement came from fertilization, pest and disease control, efficient irrigation, improved mills and machinery, and richer varieties of sugar cane. A doubling in the use of fertilizer between 1914 and 1924, coupled with the introduction of H-109, a sucrose-rich variety of cane developed in Hawaii, led to a dramatic expansion of sugar production during the 1920s when cane tonnage increased seventy-five percent throughout the islands. By 1930 Hawaii's annual production grew to one million tons, and for the next fifty-eight years met or exceeded that level, before dropping below it in 1988. However, despite producing over one million tons of sugar a year, Hawaii's sugar production began to decline in 1968, the start of an irreversible trend. Finding themselves unable to compete in the global economy, one company after another closed its doors. With the September 2008 announcement that Gay & Robinson on Kauai will soon discontinue to grow sugar as food, only one sugar mill, Alexander & Baldwin's Hawaii Commercial and Sugar Company at Puunene on Maui will remain in operation in the islands.

Between 1860 and 1940 sugar was the economic mainstay of Hawaii's economy, which, in turn, profoundly affected the islands' internal politics and overseas relations. Also, with large segments of Hawaii's land under its control, the sugar industry greatly affected land ownership, distribution of water, and the physical development of the islands. It was also instrumental in Hawaii's population growth and composition, as between 1876 and 1900, Hawaii's population jumped from slightly under 54,000 to over 154,000. During this period workers were imported from China, Portugal, Russia, Norway, and Japan to work in the cane fields. After the turn of the century Puerto Ricans, Koreans, and Filipinos further diversified the islands' work force and added to the foundation on which the islands' present multi-cultural society is based.

**The Sugar Making Process at Kekaha Mill**

The critical technology for processing cane sugar was developed over the course of the nineteenth century, and since the 1920s there have been no radical innovations in the milling of cane. Thus, the manner in which sugar was processed at Kekaha Sugar Company's sugar mill remained constant over much of the twentieth century, and much of the machinery and apparatus present in the mill maintained a long continuity of use, well reflecting the industry standards.

Once harvested, sugar cane must be processed within eight hours, otherwise it starts to ferment. Sugar cane arrived from the fields to the Kekaha Mill initially by ox cart and after 1892 by train. From 1947 onward it was transported exclusively by truck. When it arrived at the mill it was mixed with dirt, rocks, trash, and scrap metal, which needed to be removed, before the cane could be processed. The cane was unloaded onto an unloading deck equipped with a conveyor where trash was removed and the cane cleaned.

Via the cane cleaning conveyor the sugar cane entered the mill, where it passed through rotating knives where it was cut up, and then sent to a crusher and in turn to a shredder to form a uniform blanket which could be passed through the grinding mills. The crusher, two large rollers with interlocking corrugated teeth, thoroughly broke down the rind, extracting a high percentage of the juice from the cane. Next the shredder separated the fibers of the cane. The cane then moved to the grinding mills. Each mill consisted of a set of three grooved rollers, each weighing from twelve to sixteen tons, which squeezed the juice out from the cane. One set of rollers followed the other in a straight line, and each exerted a progressively finer crushing action.

By the latter half of the 20th century, Kekaha Mill had five sets of three roller mills. Once the cane had passed through the crusher and the first mill, close to 70 percent of the sugar was extracted from the cane. Hot macerating water or cane juice was applied to the crushed cane fiber as it entered the second and third mills to assist in the extraction of the remaining sugar. The macerating water or juice was not allowed to exceed 110 degrees Fahrenheit in order to prevent the wax on the cane stalks from melting and getting into the juice. By the time the cane ended its journey through the mill train, ninety-eight percent of the juice was extracted. This juice drained from the mills into collection pans and was pumped to the scales and clarifiers. The remaining fibrous material, bagasse, was conveyed to the bagasse storage house, where it was stored and eventually returned to the mill to be used as fuel to heat the mill's steam boilers.

After being extracted from the cane, the sugar juice was weighed and clarified. Primary and secondary heaters raised the temperature of the juice to two hundred degrees Fahrenheit, which is the "cracking point." Milk of lime was introduced to the juice at this point in order to precipitate unwanted particles in the juice and to neutralize the natural acidity of the sugar, bringing it to a PH of seven. The heating and addition of lime also arrested the fermentation process. Other precipitating agents were added at this time as well, and the juice was placed into large clarifiers. The clarifiers separated the juice from any remaining sediment. The muddy sediment was not discarded, but rather it was filter-pressed to remove as much sugar as possible from it, and then this juice was sent back to the clarifiers. From the clarifiers, the juice went to the evaporators.

The evaporators were a series of interconnected tanks or cells, which usually varied from three to five in number. Depending on the number of cells used, the evaporators would be referred to as a triple, quadruple, or quintuple effect. Such multiple-effect evaporators were invented in 1840 by Norberto Rilleux of New Orleans. In the post-war years, Kekaha Mill used very tall evaporators and eventually had eight of them connected to each other in a quintuple-effect. In the evaporators the juices were heated under a vacuum to evaporate the water. Water in a vacuum will boil at a lower temperature, which avoided burning the sugar and produced less discoloration of the end product. The juice passed from one tank or cell to the other, with the vapor evaporated from the juice in the first cell used to help heat the second, and so on. Each cell progressively increased the vacuum, and thereby lowered the boiling point of the juice. In the first cell the juice was heated to or above the boiling point with a maximum pressure of five pounds. The second cell had a vacuum of five inches and the juice boiled at two hundred and three degrees Fahrenheit. In the final cell, the vacuum increased to twenty six inches and the boiling point was reduced to one hundred thirty degrees Fahrenheit. This process thickened the juice and produced syrup. The juice entered the first evaporator containing approximately fifteen percent sugar or "fifteen brix" and exited the last evaporator as syrup containing about sixty five percent sugar or "sixty-five brix."

From the evaporators the syrup was transported to holding tanks. Here any impurities in the syrup settled to the bottom. The impurities were high in sugar content and were returned to the clarifiers to be reprocessed. The syrups in the various tanks were determined to be either high or low grade. From these storage tanks the syrup was sent to the vacuum pans, which could be considered as single effect evaporators. The syrup was placed in one of several vacuum pans, some used for low-grade sugar and others for high-grade. Here the thickening process proceeded under carefully controlled heat and vacuum. As a super-saturated solution was formed, sugar crystals, called "seeds," were introduced to induce additional sugar crystals to form and multiply. Crystallization was further encouraged by circulating the syrup in the pan's calandria. If the crystallization process went awry at this point, the syrup had to be returned to the evaporators and remelted. When the tiny crystals grew to a proper size, the vacuum pan was emptied, or in sugar parlance, "the strike was dropped." The viscous mixture of sugar crystals and molasses, called massecuite, was sent to the crystallizers where it was cooled while being slowly turned by spiral stirrers, originally consisting of wide blades, and later of blades made of metal tubing. The mixture was then heated to one hundred and five degrees, so it would flow more easily, and sent to the centrifugals. The centrifugals purged the sugar of the molasses. The cylindrical shaped centrifugals contain perforated brass baskets lined with a fine meshed brass screen and mounted on a central shaft. By spinning at high speed the centrifugals separated the sugar crystals from the molasses. The brown sugar crystals were conveyed to a storage bin and then shipped to refineries in California. The molasses was recycled to a Massecuite Heater and then returned to the centrifugals in order to remove more sugar crystals. The molasses was stored in a separate tank and also shipped.

The entire sugar making process at Kekaha Mill was dependent upon steam which was produced in the mill's boiler house. The boiler house furnaces were fueled by the bagasse produced after the juice was extracted from the sugar cane. The steam powered the steam engines and steam turbines which ran the crushing mills. It also powered the steam turbo-generators which produced the electricity to run the pumps, motors, and other equipment and lights in the mill. The steam also was the source of heat used in the heaters, evaporators, and vacuum pans to transform the juice to a syrup and then to crystals.

The Kekaha Sugar Company' sugar mill operated twenty-four hours a day in season, five and two-thirds days a week for thirty-seven to thirty-eight weeks out of the year. Usually the milling of a year's crop concluded in November, having begun in early March. The period between November and the start of the next year's harvest season was called the off-season. It was during this period that most of the improvements were made to the mill building and new equipment installed. During the 1920s it was estimated that the off season had to be at least two months long in order to allow for repairs and general over-hauling of equipment in the mill.

## Kekaha Sugar Company

Kekaha Sugar Company was one of the later sugar companies to be organized in Hawaii. Its origins may be traced back to Valdemar Knudsen, a Norwegian immigrant who arrived in Hawaii at the Koloa Landing on Kauai in 1857, after a successful period in the gold fields of California. He was hired to manage Grove Farm Plantation, but later leased from the crown six ahupuaa on the west side of Kauai. Knudsen's holdings extended from the Waimea River west across the plains of Kekaha and Mana, as far as the Nualolo Valley along the Napali Coast and inland into the mountains of Kokee, including Pokii, Waiawa, Mokihana, and Milolii. This encompassed between forty and fifty thousand acres of land, mostly forests, dry hills, swamps and sand lands. Knudsen established a ranch on these lands; however, in 1878, two years after the signing of the Reciprocity Treaty between the United States and Hawaii, Knudsen and Captain Hans L'Orange planted fifty acres in sugar cane. Shortly thereafter L'Orange departed Kauai, and when the crop was ready for harvest in 1880, Anton Faye and W. Meier purchased and harvested it. Meier and Kruse subleased the Kekaha sugar fields from Knudsen, and in 1884 a nephew of Knudsen, Hans P. Faye started growing cane at Mana on lands subleased from his uncle. He had artesian wells drilled to provide water to the fields, which were irrigated with the aid of wood burning pumps.

As sugar growers planted more cane, Paul Isenberg and others started a mill in Kekaha in 1880, under the management of Paul's brother, Otto Isenberg, and named it Kekaha Mill Company. Typical mills at this early date consisted of rollers that extracted sugar from cane through a method that involved running the stalks through rollers or grinders to squeeze out the juice. This method had been used for centuries by sugar makers in China and India. Hawaii's sugar farmers used it exclusively during the early years of sugar production. The juices were collected and then subjected to purification, distillation, crystallization, and separations to make sugar. The primitive water- and animal-powered three roller mills of the 1850s had rarely extracted more than 50 percent of the sugar, and the bagasse, the fibrous by-product that was left over, emerged wet and had to be spread out to dry before it could be burned for fuel. As steam engines replaced water and animal power, they enabled the mill to use more grinders to press more cane juice, to increase the amount of juice, to recover more sugar. This drive to increase capacity through improvements to machinery would remain a driving force for the next hundred years, being joined in the 20$^{th}$ century by the application of scientific practices that focused on the productivity of soil, use of fertilizers, and genetic engineering of the cane itself.

By 1886 Isenberg's mill operated a two tandem mill, manufactured by Honolulu Iron Works, with each tandem holding two or three rollers. In 1888 Honolulu Iron Works provided a new vacuum pan and pump for the mill, and the mill introduced a cast iron Krajewski crusher in 1894 to better prepare the cane before it entered the mill rollers. Other improvements followed during the 1890s. In 1896 the mill purchased for $1360 two new centrifugals from Catton, Neill & Co, which had belt-driven gears, brass linings, and 8'6" shafts. It also replaced iron parts with brass in the mill's J. Kroog-patented "filterpresses." In 1898 the mill acquired clarifiers from the Pioneer Mill in Lahaina. It also began to pay a newly-formed Meier and Kruse Pumping Company for water. Meier and Kruse utilized coal-burning pumps to bring the water up from artesian wells and springs, billing the Kekaha Mill on a quarterly basis for the water it required for the mill and irrigating fields.

After 1880, as railroads expanded across America, Hawaii's sugar planters also bought and built new railroad transportation systems to replace animals and wagons, which greatly facilitated travel time of cane to the mill. In 1892 the Kekaha Mill Company purchased twenty-nine railroad cars, and borrowed an additional twenty cars from Isenberg's Lihue Plantation Company. By 1895, the mill was using three locomotives to transport cane to the mill from fields as far away as Mana, as well as to carry coal shipments and other supplies from the Waimea wharf to the mill warehouse. By 1896 it had invested almost one-quarter of the company's assets in locomotives, railroads, portable track, and rolling track (Kekaha Mill Company, annual tax return, 1896). The next year it ordered additional railroad cars, increasing the total number to seventy. The mill continued its reliance on rail cars until it began switching over to trucks in the late 1930s, reaching fifteen miles of railroad by 1910; and peaking at twenty miles of 30" gauge railways by 1930.

In 1898, the year of Knudsen's death, Hans Faye brought these autonomous operations--the mill, pumping company, and the sugar fields at Mana and Kekaha--under one umbrella organization, the Kekaha Sugar Company. Knudsen's widow, Anne Sinclair Knudsen, subleased a portion of her property to the new company. During the 1895-96 season, on the eve of this consolidation, Meier & Kruse had 517 acres of cane that produced 2875 tons of sugar, and Faye had 535 acres producing 3010 tons of sugar. The timing of the start of this new company was close to impeccable. Between 1899 and 1965, the world's production and consumption of sugar more than sextupled, rising from eight million tons in 1899/1900 to fifty four million tons by 1965, with America being one of the world's largest per capita ingesters of sugar. No other food or agricultural product came close to approaching such growth, which far exceeded the population increases over this period.

Kekaha Sugar Company's first Board of Directors included H.P. Faye, Otto Isenberg, F.W. Glade, F.M. Meier, E. Kruse, J.F. Hackfeld, Paul Isenberg, Carl Isenberg, A.S. Wilcox, G.N. Wilcox, and S.W. Wilcox. H.P. Faye managed the company until his death in 1928. He had been born in Drammen, Norway, in 1859 and came to Hawaii in 1880, arriving on Kauai in 1882. In addition to this enterprise, Faye also owned and operated the Waimea Dairy and, by 1916, had acquired the Waimea Sugar Mill Company, which his son Alan Faye managed. Another of his sons, Lindsay A. Faye, would later become manager of Kekaha Sugar Company from 1935 to 1963.

The company expanded its milling capacity in 1906, when it replaced its six roller mill, with a more up-to-date three roller mill. In addition the company focused its attention on developing additional water sources. The company's predecessors had relied on springs and artesian wells in the early years to provide its needed supply of water due to the region's lack of rainfall. By the early 1900s, this water supply had declined due to drought and overuse, and a renewed effort was made to bring water from the Waimea River to irrigate the fields. By September 1907, a new Kekaha ditch was built in conjunction with the construction of a hydro-electric plant to utilize the water available from this large river. The sugar plantation eventually relied on a combination of ditches, drains, flumes, and pumping stations to move water to the fields and supply power. In 1913 the mill further developed its hydropower to provide electricity to power irrigation pumps, so it could expand the planting of cane on the nearby mountainside as far as the 1,100 foot elevation, thus adding 1,600 acres.

By 1917, the mill had increased its annual production to 19,172 tons of sugar, compared to 7,592 tons in 1899. In 1919 the company harvested 2,600 acres of cane and had approximately 4,600 acres under cultivation, which included 3,000 acres on the plains and 1,600 acres on the lower part of the hills. There was an additional 600 acres in rice, and the remainder of the Knudsen property in ranching.

Between 1900 and 1920, the Hawaii sugar industry experienced considerable change in equipment and milling practices, as mills upgraded their equipment with new, improved parts and installed more efficient machinery and additional units. Kekaha Sugar Company, however, was cautious when it came to capital expenditures on improvements during this period, keeping in mind that their lease with the Territory of Hawaii for all the sugar company's land was due to expire in 1920. In 1914, Christion J. Hedemann, the general manager of the Honolulu Iron Works, was asked to inspect the operations at Kekaha as "conditions have not been very satisfactory." (letter, Hackfeld to Faye, June 5, 1914, HSPA, KSC 19/4). Hedemann expressed his opinion that the mill train was not operating at its highest efficiency and suggested new, larger rollers, pointing out that the crusher and first mill "are not doing the good grinding now considered essential to efficient extraction," since the machinery had been in constant operation since 1906, and the rollers were not wide enough (letter, Hedemann to Hackfeld, June 4, 1914, HSPA, KSC 19/4). To improve the situation somewhat, Faye rehabilitated the mill's rollers by providing rollers with Messchaert grooving, which were an improvement already employed in over sixty percent of Hawaii's mills. Developed in 1913 by P. A. Messchaert, the mill superintendent for Oahu Sugar, these new, improved grooves in the surface of the rollers were somewhat deeper and wider than those formerly in use, and they greatly reduced slippage as the cane passed through them and thus improved the extraction of juice. Also, in response to Hedemann's recommendations, Faye approved the purchase of a new, steel Krajewski crusher in

1914 and added a new carrier for the crushing mill the next year. During this period, other low-cost improvements to increase cane juice extraction included using hot water for maceration and the improved preparation of cane through more efficient knives and shredders. By 1920 knives were in use at most of Hawaii's mills and shredders at one third of them. In the boiling house, Faye added a new heater in 1914, and rather than replace a vacuum pan in 1916, he had Honolulu Iron Works fabricate a new calandria for the pan.

In 1919 power to the mill was supplied by five boilers, which were the return-tubular type, set in tandem, and all were in poor condition with more than normal corrosion, considering their fifteen to nineteen year ages, and in some instances the rivet heads were almost gone. These were no longer performing at peak efficiency. The circumferential seams on the front drums of boilers no. 3 and no. 4 leaked.

When the Knudsen lease terminated in 1920, Kekaha Sugar Company successfully renegotiated a new 18 year lease with the Territory of Hawaii. In addition, in 1922, the company bought from the Territory the forty acres on which its mill and worker housing stood.

With its new lease in hand, fee-simple ownership of the land under its mill, and flush with profits resulting from the high sugar prices enjoyed during World War I, during which time competition from Europe's beet sugar factories had been suspended, Kekaha Sugar Company invested major money in the expansion of its operations during the 1920s. It greatly increased the lands under cultivation by draining 2,200 acres of marsh and wastelands at Nohili and Kawaiele in 1922, where it planted cane on the reclaimed land. While the new low-land fields increased the amount of cane produced, this alone did not account for Kekaha's tremendous boost in sugar production during the 1920s and 1930s. In addition, commencing in 1918, Kekaha began to plant a variety of cane known as H-109, which was a newly developed hybrid that had a higher sugar content than the formerly-used Lahaina cane. In subsequent years H-109 became almost the exclusive cane planted at Kekaha, representing ninety-eight percent of the 1931 harvest. Between 1920 and 1930, while the sugar company increased their annual harvested acreage from 2,644 to 4,391, its sugar production almost doubled, going from 18,540 tons in 1920 to 36,396 in 1930.

Another factor in Kekaha's increased sugar production was the upgrading of the mill. In part the improvement to the mill was propelled by the increasing tonnage of cane being harvested year after year, but the poor condition of the existing wood buildings and old equipment also necessitated a series of improvements. As Alexander Lindsay Jr. noted at the time of the lease renegotiation in 1918:

> The present mill is so out of date and worn out that without substantial repairs it might not outlive the lease. Even now it is inadequate to handle the crops produced, and, but for the

> rapidly shortening term [of the lease] would have long since been relegated to the scrap heap and a modern mill erected. Its capacity is so limited that, in order to handle the amount of cane produced, it is necessary to run the mill throughout the whole year. (Lindsay, "Notes Regarding Kekaha Lease, HSPA file KSC 1-7)

Over the next few decades, the old wood-framed mill buildings were gradually converted to a fireproof steel-framed factory, and the mill's capacity increased due to the purchase of new equipment to replace and augment the existing machinery. To start, the company upgraded the boiling house. In 1921, Faye ordered from Honolulu Iron Works two new 10' vacuum pans with bronze calandria and cast iron domes with a capacity of 730 cubic feet; as well as four centrifugals and a new 9'-6" diameter evaporator. The latter was added to the existing three evaporators to give the mill a thoroughly modern quadruple effect. The quadruple effect evaporators had cast iron calandria and domes and were sheathed with wood lagging or magnesia blocks. They were all provided with Stillman save-alls. To go along with the new evaporator, the mill also acquired a condenser measuring 4' in diameter.

Improvements to the boiling house continued the following year as new heads were placed on the heaters that had been installed in 1914, two more centrifugals were purchased, and new filter presses. In addition, quotes were received for sixteen crystallizers, measuring 8' wide x 8'-8" deep x14'-6" long. These crystallizers were constructed with 7/8" x 3" flat steel helix connected to a 4-1/2" square steel shaft by means of flat steel arms. Although they were to have a cast-iron worm wheel at the front, driven by a chain and sprockets for a counter shaft, it is uncertain if these were purchased.

The company next updated its boiler room, obtaining three new boilers, measuring 7' in diameter x 19'-11" tall, from Honolulu Iron Works in the summer and fall of 1923. The increased in length over the older boilers, which were typically 10 or 12 feet long, was an improvement in economy, as the longer boilers would give more steam with the same amount of fuel. The increased steam power which these boilers brought to the factory set the stage for an expansion of the crushing mill itself. In 1924, two additional 32" x 60" mills were installed by Honolulu Iron Works, upgrading the former nine-roller tandem to a fifteen-roller operation. The old tandem's equipment was refurbished with the addition of new gearing, gear beds, pillow blocks, cheeks, and caps, as well as a new juice strainer. The two new mills became the fourth and fifth in the mill train, and the existing 16" x 36" Hamilton Corliss Crush Engine was used to drive them. A new 28" x 54" Hamilton Corliss Steam Engine was purchased to drive the first three mills. The mill's traveling crane was extended an additional 54'. The new mills were hydraulically regulated, with new cast iron beds, cast steel gearing with stub teeth and gear beds. This upgrade enabled the mill to grind forty tons of cane an hour.

The demand for more power continued throughout the decade, and in 1929 another tube boiler was purchased from Honolulu Iron Works, and a four-year-old boiler was brought over to Kekaha from Waimea Mill. In 1930, a C.E. Walsh & Weidner water-tube boiler was installed as well.

The annual report for 1928 notes that a new set of Ramsay knives was installed, that allowed 20 percent more cane to pass through the mills, and four large centrifugals were added to process the low-grade molasses. In December 1928, the company's board of directors authorized the purchase of a new Niles Bement Pond electric crane and a new baffled-type calandria vacuum pan by Honolulu Iron Works, which measured1,200 square feet. Baffling was an improvement that added increased heating capacity per square foot. This vacuum pan was the largest of the mill's four pans, joining two 1922 Honolulu Iron Works pans, which were each 735 square feet, and a 1915 pan, which measured 388 square feet, built by Stade and used for low-grades. The board also discussed upgrading the machines for boiling low grades with mechanical stirrers that were intended to increase recovery.

The decade of the 1920s was a prosperous one for Hawaii's sugar industry, so that despite the Great Depression and reduced productivity of the industry due to quotas established by the Agricultural Adjustment Act, Kekaha Sugar Company made fairly substantial capital improvements to their physical plant during the 1930s. Between 1929 and 1939 the company invested approximately a quarter of a million dollars in factory upgrades, with much of the spending coming in the last half of the decade. Between 1929 and 1933 during the depths of the depression, however, several improvements were undertaken.

In 1930 a major improvement transpired when a steam-operated electric power generation plant was added to the mill. The company already owned two hydro-electric plants; the first power plant at Waiawa was started in 1907 and the second in Waimea Canyon was installed in 1912. However, these hydro-electric power plants could not provide a steady and dependable power supply because low stream flow delivered only a minimum of power when it was needed most, which was during the summer months while the factory was operating at high capacity.

The new steam power plant contained a 1500 KW, 60-cycle, Westinghouse Turbo-generator and also a Westinghouse surface condenser with 1,775 square feet of cooling area. The steel-frame building measured 28' x 52' and 30' to the bottom of the crane hook, and it was placed adjacent to the machine shop and the boiler house. It had eight vented steel sash with wired glass, each 6' wide x 5' high, arranged four in each sidewall between the columns. There were no windows in the end walls. The crane was a traveling type with a geared trolley and chain hoist for a ten ton lift. The roof ridge had two 30" diameter American Larsen Suction type ventilators, and its walls were made of corrugated sheets. In converting from the former 25-cycle operation to a more efficient 60-cycle one, the company also had to install five new factory pumps, new irrigation pumps, and temporary power lines. In addition, it acquired new generators for the Waiawa and Waimea power plants.

The advent of the electric-generating plant led to further improvements to the boiler house the following year, when Kekaha Sugar Company acquired a second Walsh & Weidner water tube boiler with a 614 horse power (hp) capacity. The new boiler was needed to provide 250-degree steam for the newly installed 1500 KW turbo-generator.

To handle the new boilers' smoke and exhaust, a new 205' high chimney was constructed of tapering, reinforced concrete. It measured 10' in diameter at the top and 15' in diameter at the bottom, and was purchased for $12,000 from The Weber Chimney Company of Chicago. Fifty wooden piles were driven into the 28-foot-deep coral stratum to build the foundation, and the walls were 12" thick at the base.

Between 1929 and 1933 the mill carried out several upgrades to the boiling house. Starting in November 1929, it purchased four 40" Western States self-discharging centrifugals with tapered-bottom bronze baskets from Honolulu Iron Works, adding two more in May 1931. Also in 1931, a new clarifier manufactured by Petree & Dorr Engineers, Inc. of New York was installed. Previously, in the old clarifiers, the juice was warmed by an exhaust steam passing under the bottom of the pan, and by the time the pan was full, the scum had risen to the top so the juice at the bottom of the pan could be drawn off in a clear state. If the pan boiled, however, it would break the scum and it was impossible to remove the dirt from the sugar to make it a good grain or good color. The new 18' five-compartment Dorr clarifier with a 26,500 gallon capacity, adapted from the beet sugar industry, was designed to heat the juice efficiently avoiding dead spaces in which the juice did not circulate, and thereby speed up the clarification process without risking the juice's boiling. Its compact size furthermore provided the space to use high-quality insulation that would provide a heat-saving benefit. At the time of its installation the Dorr Clarifier was considered the outstanding development in clarification equipment for cane sugar manufacture ("Recent Development in Factory Practice and Equipment," *Gilmore's Hawaii Sugar Manual,* 1931-32, p.51).

In 1931 the mill also installed a new Oliver-Campbell Filter to replace the old mud presses. The Oliver filter was an improved machine introduced in the mid-1920s for the disposal of "settlings," or mud by-products, of the clarification process. The successful use of the Oliver filter in two Hawaiian factories was named as an outstanding development in filtration practice in 1931 ("Recent Development in Factory Practice and Equipment," *Gilmore's Hawaii Sugar Manual,* 1931-32, p.51). Based on the date of its installation, Kekaha appears to have been among the earliest mills in Hawaii to use an Oliver filter. The newly-designed machine had an 8' x 9' filter with a screen area of 225 ft, and one Westco and two Oliver bronze centrifugal pumps to recover sucrose from the settlings from the Dorr Clarifier. Shortly after it was installed, the mill's manager wrote to American Factors, his agent, that the new filter was "very clean" and the "floor was now as clean as the Boiling House" (letter, KSC to American Factors, dated 7/3/1931). The next year the mill installed its second new 8' x 9' Oliver-Campbell Filter.

Other boiling house improvements included a new baffled juice heater, measuring 1,420 square feet, which was installed in 1932. The following year, management rebuilt the low-grade evaporator pan and converted the crystallizers from belt to chain drives. Water-cooling tubes were added to the last three crystallizers. The water-cooled crystallizers had cooling coils that were integral with the stirrers with water entering and leaving through the ends of the shafts. In 1934 six more crystallizers were upgraded with cooling and heating coils, and the old mixing tanks were replaced with an improved design that had enclosed, insulated tanks equipped with stationary heating coils. The following year, eight more crystallizers were equipped with cooling coils. In 1935, the company invested in a new 1800-cubic-foot vacuum pan.

Between 1934 and 1939, with Hawaii's economy starting to recover from the Depression, major improvements were made to the mill building. These included the incremental replacement of the old wood mill building with a steel-framed and corrugated iron walled building as part of a larger conversion of the entire mill to these more durable and fireproof materials. The first phase of the project commenced in 1934, when a steel building was erected over the boiling house, and a year later a steel structure replaced the old wooden building over the crystallizers. The new wing was designed so the crystallizers could be raised to a new floor level, 22 feet above their previous level, to enable the heavy massecuite to flow by gravity to the centrifugal mixer and centrifugals. A year later, the new layout was accomplished when the crystallizers were moved to their new elevated position, and the low grade centrifugals were moved from their cramped position near the boilers and placed under the crystallizers. In 1938-39 the mill extended a steel structure over the evaporators and the vacuum pans, and also during 1939 completed a new, wood frame, free standing factory office. The old factory office was located west of the machine and repair shop and interfered with the planned expansion of this shop. Once the construction of the new factory office was completed, the old office was removed, and a steel and corrugated iron machine and repair shop was built, immediately to the west of the wood frame crushing mill.

Other capital improvements during 1940 included the building of several free-standing buildings on the mill site, including a blacksmith shop, carpenter shop, and automobile and tractor repair shop. These would be the last significant changes made at the mill site until after World War II, and it was not until the 1950s that the dream of an all-metal building was realized. Almost all these structural improvements were made under the direction of Lindsay Faye, who succeeded William Danford's short tenure as general manager of the Kekaha Sugar Company from 1928 to his death in 1935.

In addition to reconstructing the physical plant along more durable lines, Lindsay Faye also oversaw the introduction of mechanical harvesting of Kekaha's sugar cane. Beginning in 1935 the company acquired three Bucyrus-Erie loading cranes, which handled approximately two thirds of the harvest, reducing labor needs by approximately fifty men. In 1936 the mill introduced mechanical harvesting to cover all loading operations, and by 1940 had completed the transition to total mechanical harvesting of cane. Difficulties encountered in the factory handling of the dirt and trash of mechanically-harvested cane delayed operations and led to installation of one of Hawaii's first cane cleaning plants in 1938. Initially, the new washing plant included a trash separator and washer, but by 1940 it had been remodeled to include a rock separator and increased trash removal facilities. The cane cleaning plant relied on unloading the cane from railroad cars to the mill carrier by means of a power-driven rake or unloader. In 1938 trucks replaced flumes as the means of transporting the cane from the company's upland fields to transfer points along the railways where the railcars awaited to take the cane to the factory. Trucks incrementally supplanted the train in bringing the cane to the mill, and in 1947 hauling by rail was discontinued, with trucks also transporting the sugar the eleven and a half miles to Port Allen.

Concentrating on improvements to the fields and factory buildings, the company spent little on equipment during the late 1930s. However, four high-speed, direct-driven low-grade centrifugals were added, bringing the total to sixteen, which included four ATM and twelve Western States. There were also six high-grade, electric centrifugals by Western States. Other improvements included baffling and re-tubing the 3$^{rd}$ and 4$^{th}$ evaporators to increase the heating surface to 1200 and 750 square feet respectively. These evaporators were arranged so that the old four-body evaporator served as a pre-evaporator, and the others were hooked up in a quadruple effect. During 1938, the mill also installed automatic juice scales and liming controls.

By 1938 the major equipment in the boiling house included one Dorr clarifier, two Oliver-Campbell mud filters, syrup and remelt tanks, each holding a capacity of 3,000 gallons, and three 1,106 cubic foot tanks for molasses. There were three high-grade vacuum pans; two with 9' diameter calandria (790 and 735 cubic feet capacity), and one with 14-1/2" diameter of 1,800 cubic feet capacity, as well as two low-grade pans, each with a 9'diameter and a 735 cubic feet capacity. In addition there were nineteen U-shaped crystallizers, each with an 800 cubic foot capacity, equipped with cooling coils; and two massecuite heater mixers. At this time, the mill was able to operate at a capacity of seventy five tons of cane per hour.

The outbreak of World War II had a profound effect upon Hawaii and its sugar industry. For the two weeks following the bombing of Pearl Harbor, Kekaha Sugar Company was completely shut down, with most of the mill's men and shop facilities devoted to military operations. Throughout the war, the company, as well as the sugar industry in general, was constrained by a limited labor force. The plantation was fortunate in being one of the pioneers in mechanized harvesting as other plantations had to make this conversion and all the adjustments it entailed over the course of the war as field hands became harder and harder to employ. At Kekaha the company continued to refine the cleaning plant, adding Olson trash eliminators in 1942 and again in 1943. It also appears to have carried out mill improvements. According to the company's 1944 Annual Report, three years of intensive factory renovation were beginning to show results. These improvements included the acquisition of a new baffled heater, a five-compartment Seip clarifier, and new pan supply tanks with six each for syrup and molasses. In addition, the crystallizers were reduced in number to ten and all were equipped with Blanchard coils.

Manpower shortages remained the most serious obstacle to successful operation of the mill throughout the war years, with 1945 being especially difficult. As a result, in that year Kekaha's mill began grinding Waimea Plantation's sugar. This not only helped keep the mill supplied with cane, but also provided additional mill workers through the employment of personnel from Waimea Mill.

Despite difficulties, production statistics remained higher than might be expected, the result, in large part, derived from the increased use of a new hybrid sugar, 32-8560. The introduction of the 32-8560 variety of cane led to a rise in Kekaha's sugar production to over 40,000 tons a year. The H-109 variety, which had been used throughout the 1920s and 1930s, had proven to be susceptible to "Eye Spot" disease and also was not well suited for mechanical harvesting. In June 1942 the 32-8560 variety set a record when one 60 acre field produced 139.32 tons of cane per acre, which when processed yielded 17.97 tons of sugar per acre.

Following the war, Kekaha Sugar Company resumed its long-range program of replacing wood with steel framing and corrugated iron, building a steel structure over the boilers in 1947, which left only a portion of the sugar room and mill train building still in wood. The company also embarked on the installation of new long-tube evaporators, manufactured by Goslin-Birmingham Co. in Birmingham, Alabama. The Kekaha Mill was the first cane sugar mill in the world known to employ long tube evaporators, which had been used for years in paper mills, as well as in a beet sugar factory in Woodland, California. Management at Kekaha Mill considered the all-steel, long tube evaporators especially attractive, as they were 20-30% cheaper than cast iron, copper and muntz metal evaporators, and they required less floor space, only 27'-7" x 40', allowing them to be installed during the grinding season without interruption to production. In addition, their all-steel construction made changes and repairs more easy to accomplish. There were concerns, however, about the cleaning of the tubes, which exceeded 24' in length. Also, the long tube units carried a very small quantity of juice per unit, so the cells had to be maintained in a careful balance or evaporation noticeably slowed down. Because of this need for balance, automatic controls were installed at Kekaha for the evaporators after only a few seasons. Kekaha Mill was one of the few sugar mills in Hawaii to use long tube evaporators, with the Hawaiian Agricultural Company's mill at Pahala on the island of Hawaii possibly having them as well.

Other dramatic changes continued into the 1950s. In 1950 the sugar industry throughout Hawaii decided to abandon the shipment of sugar in bags and to ship its product in bulk. As a result the wood-frame sugar room where the sugar crystals were bagged was abandoned, and a 400-ton bulk sugar storage bin was installed at the mill site. By early 1951 the mill had completed this transition to bulk sugar storage and transportation systems.

Another significant change at this time transpired when the mill changed its utility system. Management made improvements to the power plant by adding a new 800 hp boiler and 2,500 KW turbo-generator to supply power for all factory and irrigation needs, while stopping electric utility service to outsiders and plantation employees and transferring them to Kauai Electric Company. They also tied the mill's power system into the outside utility to assure the mill of power during an emergency and provide some revenue from excess power sold to the utility.

During 1952-1955 Kekaha Sugar Company carried out a two million dollar upgrade to its milling operations that included new centrifugals, a new steam generator, as well as a new mill train. Discussions concerning the replacement of the crushing mill had been on-going since 1933. The old crushing plant, parts of which had been in operation for almost fifty years, was, by 1952, determined to be in poor condition and too small, according to the annual report. The company further justified its need to maximize capacity because of the, "shorter work week of today with its heavy penalties of overtime" (annual report, 1951). As a result, a completely new mill train, capable of handling 125 tons of cane an hour, and housed in a new steel framed, corrugated iron walled mill was constructed.

Completed in 1954, the new crushing plant, which cost $1,070,000, was the first all-turbine-driven cane crushing plant in Hawaii. At the time of its installation by Honolulu Iron Works, it was also distinguished by being the longest and heaviest mill in the territory. The tandem measured a hundred feet long with seventeen 38" x 78" rollers, consisting of a crusher and five mills driven by six individual 450 hp, multi-stage steam turbines. In addition, the mill tandems were all equipped with feeder rolls. In replacing the old 32" x 60" rollers, some of which were almost fifty years old and had a maximum capacity of only 74 tons of cane per hour, the mill achieved better extraction of juices and flexibility in operations, thereby reaching the desired capacity of 125 tons of cane per hour, with further peaks of 150 tons per hour. The power produced by the steam turbines required reduction gears between the turbines and mills to handle the torque, and the new engines, unlike the old ones, could be electronically controlled by one person.

To house the new crushing plant, the mill constructed a new steel-framed building on the east side of the boiling house in 1954. The old wooden sugar room and the free standing, wood framed laboratory were removed in 1952 to make way for the new plant, and a new laboratory was put in the boiling house on the west side of the first floor. General laboratory work experienced a steady expansion in its scope of work during this period and reflected the increasing focus of the sugar industry on the science of production. The laboratory was originally started to check the work of the mill and factory, but it expanded to include tests on irrigation water, recharging fire extinguishers, soil samples, fertilizer ingredients in the cane from different fields, boiler waters, checks on massecuite heating, etc ("Laboratory Routine," by J. H. Pratt in Gilmore's Hawaii Sugar Manual, 1938-39, pp.50-54).

A battery of ten new centrifugals was added in 1953, in anticipation of the completion of the crushing mill. These were hydraulically-driven low grade machines that replaced older belt-driven models, some of which were thirty years old. These new centrifugals measured 30" x 40" with speeds of 1800 RPM, and, at a cost of $175,000, they were intended to increase the capacity of the centrifugal station up from 80 to the desired 125 tons of cane per hour.

The final component in the factory improvement program was construction of a new automatic steam generator. In the summer of 1953, the foundation was laid for a new steam generating plant that, at a cost of $490,000, would provide the mill with one large high-pressure steam generator to replace all the smaller boilers and provide cheaper power. The 700-ton generator was the first of its type developed for the sugar industry and had twice the capacity of any boiler unit then operating in the Hawaiian sugar industry (Annual Report, 1953). It was a 415 psi unit that generated 150,000-190,000 pounds of steam per hour, compared to the 80,000 pounds that the nine old boilers combined generated. The new steam plant took over a year to build and went into operation in April 1955. The plant had no building around it, standing nearly 70' in the air with a stack made from two surplus 10' x 40' tanks mounted on one end. It featured tangential-suspension and a fully automatic control, which replaced nine manually-operated smaller boilers. The new generator was also bagasse-burning, which had saved the mill over 20,000 barrels of oil by the end of 1955 (Annual Report, 1955). The efficiency of this new generator, however, exacerbated the problem of surplus bagasse, which would require the construction of a new bagasse storage house in 1965.

Following the two million dollar upgrade, Kekaha Sugar Company carried out a major improvement program to the boiling house to increase its capacity so it was in balance with the crushing plant. Almost immediately, the increased capacity of the new crushing plant created the need to increase the capacity of the mixed juice and clear juice receiving tanks. During the off-season at the end of 1955, the mill removed No. 3 and No. 4 H.R.T. boilers, which had been replaced earlier that year by the new turbo-generator, and moved these old boilers into the boiling house to replace the older mixed and clear juice tanks. The Factory Superintendent was pleased that this saved, "considerable money for new material and labor (letter dated August 18, 1955, from C.H. Macalister, Factory Superintendent)."

In addition, from 1956 to 1957, the mill purchased new equipment that included a vacuum pan and a juice heater, both of which were in operation by the 1957 grinding season. The company installed a new Seip multi-tray clarifier manufactured by the

Graver Tank and Manufacturing Company of Chicago. This clarifier offered an improved sludge filtration system designed to settle and filter the sugar juice, removing mud and leaving a clear, finished liquid. The mill decided to install a third Oliver-Campbell mud filter and an evaporator cell. In 1958 the mill installed two new seed pans and replaced the old calandrias in two of the vacuum pans. It also equipped four of the crystallizers with water-heated coils, an improvement that made the machines more efficient by speeding up the crystallization process ("Crystallizers and Their Control," by Raymond Elliott, in Gilmore's Hawaii Sugar Manual, 1938-39, p. 46). During the 1959-1960 off season, the mill added another set of four new high-grade centrifugals, which replaced a bank of six old ones, and installed a new enlarged sugar elevator that could transport greater amounts of the sugar crystals to the sugar bin.

Changes in management occurred in 1959 when the sugar company merged with American Factors. That year a new shredder was installed in front of the crusher, and the company purchased a second hand turbo-generator in Nevada, possibly because of additional steam production, which it installed in 1960. At this time, Kekaha was estimated to produce 20 percent of Kauai's electrical supply.

The mill continued to make improvements throughout the 1960s. In1964 it installed continuous crystallizers for fully automated molasses handling and eliminated the labor-intensive hand cleaning of the evaporator tubes by treating the sugar juice with magnesium oxide and lime. In 1965 it painted C & H (for California & Hawaii) above Kekaha on the stack, to advertise the brand name under which its sugar was sold. It erected the structural-steel framing for a new bagasse storage warehouse, which was completed by 1966. The evaporators were rearranged and eight new Silver low-grade centrifugals replaced fourteen Western States centrifugals in 1966. A new building for the compressor was constructed in 1967, and the company merged in 1969 with Waimea Sugar Company.

During the 1970s, few improvements were made to the mill. The highlights in this period include the building of a new storage tank for molasses and the installation of a new primary juice heater in 1972.

The mill operated until November 2000, when it shut down. At the time of its closure, it was one of four sugar mills to remain in operation in Hawaii. Maui's Puunene and Kauai's Makaweli and Lihue still processed cane. However, Lihue shut down at the end of 2000, and Makaweli announced its intention to discontinue raising sugar as a food crop at the end of 2008. In 2005 Pacific Funds LLC purchased the Kekaha Sugar Company property, and in August 2007 Kekaha MS, LLC acquired these lands and buildings.

GENERAL DESCRIPTION AND LOCATION

The mill for Kekaha Sugar Company, the most prominent landmark in the plantation town of Kekaha, is located on Tax Map Key (TMK) parcel 1-3-011: 006 and Tax Map Key 1-3-007: 104, an approximately 21 acre site on the northwest coastal plain of Kauai in the ahupuaa of Pokii. The mill and its ancillary structures sit on the south side of Kekaha Road, formerly known as Government Road, and run parallel to the road.

The Kekaha Sugar Company's mill property includes six buildings, as well as a number of ancillary structures. The historic buildings include the sugar mill, bagasse storage building, a warehouse, automotive and tractor repair shop, service station, and factory office. The sugar mill is addressed in this report and the other five buildings are covered in separate reports. In addition there are within the mill yard a concrete foundation of a former warehouse, a seed treatment plant, compressor shed, two molasses tanks, and a fuel oil tank. These will be addressed in the discussion of the sugar mill.

The Kekaha Sugar Company mill building presents a relatively coherent design, although it is the product of several building programs, the most significant of which involved the upgrading to steel framing from the mid-1930s through the mid-1950s, and the addition of a new mill tandem and boiler plant during 1953-1955. The three-story building's cleaning plant and machine, metal, and electrical shops present a long, mountain-facing façade to the street, while three wings, housing the crushing plant, boiling house, and boilers, run perpendicular to the machine, metal and electrical shops toward the ocean in a southerly direction. The mill's various sections are given design coherence through their use of similar materials: corrugated metal siding and roofs, steel windows, and steel structural members.

**Cleaning Plant**

Kekaha's cleaning plant was one of the earliest such systems to be constructed in Hawaii. It was built out of necessity to address the presence of additional dirt, rocks and trash which arrived at the mill with the cane following the introduction of mechanical harvesting methods. Initially constructed in 1938, it has undergone some modifications over time as further innovations improved its washing and trash removal capacities. Rock gaps and Olsen trash removers were added in 1943, and its carrier was widened from 6' to 10'. During 1975 its cane unloading boom was replaced, and in 1995 the number 1 rock and mud conveyor was modified. The original Ogg unloader has been replaced, and the unloading hook has been modified over time, with the most recent change occurring in 1995.

The Cleaning Plant runs from east to west paralleling Kekaha Road for approximately 150' prior to entering the mill. It is uncovered and comprised of a series of conveyors and cleaning mechanisms supported by an 8" steel I-beam framework, which ranges from 20'-24' in height. Steel platforms with grated floors provide access to the equipment at various levels. As is true throughout the mill, the grated floors are made from a variety of materials including expanded steel, perforated steel, press-locked bar grating, welded rebar, and grip struts.

At the eastern end of the Cleaning Plant, a feeder table extends outward in a northerly direction. The feeder table is essentially a 46' long, 30' wide, inclined conveyor with a bed composed of three 10'-wide conveyors, and metal plate sides, which is surmounted by a 52' high unloader at its north end. Metal steps lead up to the platform from which the unloader is operated. The unloader is comprised of a pair of triangular-shaped booms that support a giant hook that grasped the beds of the cane trailers and lifted them up and dumped the cane onto the feeder table, which has a 40 ton capacity. The two identical booms are 29'-9" long and are made of 8" steel box channels with six sets of 2" x 2" angle iron cross braces. The hook is attached to a pair of steel cables which are raised and lowered by a pair of winches powered by Toshiba three phase induction motors with Westinghouse gear drives.

The feeder table intersects the cane cleaner's dry conveyor at a perpendicular angle and dumps the cane onto the conveyor. A second chute at the end of the dry conveyor also dumps cane onto the conveyor. This chute was added in 1997, when a second cane unloading station was built. The newer unloading station is situated approximately 135' east of the original Cleaning Plant, where it was moved in 1997. It was originally installed in the Eleele Mill, and when that mill closed in October 1974, the unloader was moved to the Koloa Plantation Mill. In turn, the unloader was relocated from Koloa to Kekaha in 1997. The unloader is comprised of an operator's cab, a stationary steel frame crane, and an engine to power the crane. The crane sits on a 16' x 35'-9" concrete foundation with a curb at its western edge. Its 40' high steel boom supports a large metal hook suspended from wire cables. Immediately to the west of the unloader is a 13' wide concrete driveway which has a 60' long, 10'-1" high metal plate wall on its west side. Trucks loaded with cane drove up next to the unloader; and the hook grasped the beds of the cane trailers and lifted them up and dumped the cane onto the other side of the metal plate wall. From there a backloader transported the cane to the cleaning plant, dumping it onto the dry conveyor.

A Case Hydraulic Boom Hoist on a traveling table, sheltered by a north-facing gable roof, managed the flow of the cane at the juncture of the feeder table and the dry conveyor, shunting all large rocks onto a rock removal conveyor that ran in a southerly direction, perpendicular to the cleaning plant's dry conveyor. Beyond the junction with the rock removal conveyor the dry conveyor ascended, at a twenty seven degree angle, to the number one carding drum, which is approximately 20' above the ground. This revolving metal cylinder with projecting prongs further disengaged the stones, dirt and garbage from the cane, with the unwanted materials falling down to a basin below. A 25 horse power (hp) U.S. Motors Varidrive motor powered the first carding drum. From this carding drum, the cane dropped down to a second dry conveyor which transported it upward at a twenty seven degree angle. Any smaller pieces of cane, called "shorts," which the carding drum separated out with the rubbish, were placed on a reclaiming conveyor that led to the main return conveyor where the shorts were dumped back onto the dry conveyor. The 42-foot-long dry conveyor was powered by a 50 hp Westinghouse Electric Motor connected to a Falk Gear Box, and it transported the cane to the second carding drum, which functioned the same as the first. This carding drum was powered by a General Electric 30 hp induction motor connected to a Gyrol Fluid Drive and a Falk Gear Box. From this carding drum, the cane fell down into a rock gap, through which more of the dirt, rocks, and trash fell. A series of three rock conveyors on the south side of the cleaning plant moved this debris to trucks which transported it back to the fields. Again, a return conveyor delivered the shorts back to the cleaning plant's main conveyor.

From the rock gap, the cane traveled upward on the number one cascade conveyor, which was set at a thirty two degree angle with the ground. Four rows of spray washers cascaded water down upon the cane, further separating any remaining dirt from the crop. At the top of the 40' long number one cascade conveyor the cane passed through a series of combing drums and then passed through a series of collar, or bumper, rollers. At this juncture it entered the mill building dropped to a number 2 cascade conveyor, set at a twenty five degree angle, which transported the cane to the final carrier, which ran perpendicular to the cleaning plant and transported the cane to the crushing mill tandem.

At the end of the cleaning plant, sitting above the conveyor, is a small office from which the cleaning plant and its operations were controlled. It is accessed by seventeen steps from the grated platform.

Under the cleaning plant runs an open, concrete and brick lined ditch which is 3' wide and approximately 16" deep, which gathers the excess waters used in the cleaning process. It flows in an easterly direction, terminating in a holding basin. From here the waters are pumped to a mountain reservoir, and eventually are utilized to irrigate the new fields of sugar cane.

The conveyor which brought the cane to the crushing mills has been removed, and the end of the cleaning plant conveyor was modified in 1999 when Kekaha Mill was shut down. At that time a conveyor was installed beyond the collar, or bumper, rollers, which ran perpendicular to the cleaning plant in a northerly direction. This system transported the cleaned cane to trucks, which hauled the final Kekaha Plantation crops to Lihue Mill to be processed.

**Machine, Metal and Electrical Shops**

The Cleaning Plant flows into the Machine, Metal and Electrical Shops without any demarcation other than the cessation of the cleaning plant equipment. The shops are essentially one large, open space, approximately 54' x 287', with a concrete floor, although they were constructed in two episodes. The three-story, 57'-6" high, eastern end of the shop occupies the space which originally housed a seventeen-roller crushing mill. When the new mill tandem was constructed in 1954, this older structure was upgraded with metal framing and walls and became the machine shop. The lower, 47'-6" high, west end of the shop building was added in 1939 to house the metal and electrical shops. The eastern end is seven bays long, while the western addition is eleven bays in length. The bays in both sections are demarcated by Fink trusses with king posts, and covered by gable roofs with monitors. The trusses are supported by 8" I-beam posts, which are on average, 18'-10" on center in the older section and 13'-2" on center in the new. Railroad tracks are imbedded in the floor of the western section.

The machine shop's north wall is characterized by corrugated metal walls with steel framed windows. There are three sets of pivot windows in each bay in each of the three stories. The windows feature a six-light, pivot-framed on the top and bottom by three lights. On its south side, the shop is open to the boiling house, except in its western-most bay. In this bay a 17'-2" x 12' office, situated in the boiling house, fronts on the machine shop. It has corrugated metal walls, and has a centered metal door flanked on either side by a pivot window similar to those in the shop's north wall. Two similar windows are in the office's west wall, while one such window is found in both the east and south walls.

The metal and electrical shops are to the west of the machine shop. Their north wall has windows only on the first story. In each of this structure's eleven bays there are two sets of six-light awning windows framed on the sides and bottom by nine lights, except the eastern most and the fourth from the western end, each of which have door openings with up-sliding, chain link gates. The three bay western terminus of the electrical shop has fenestration consistent with the other bays in that shop. All the windows in this section have wire glazing. On the south side, the eastern-most bay opens onto the boiling house. The next three bays contain a series of three rooms. Each room has a wood door in a metal frame. The last five bays, approximately 75' long, are dominated by three tool rooms whose wire mesh walls, with a corrugated metal dado, open to the machine shop. These appear to be a recent addition, which extends off the south side of the machine shop and is covered by a shed roof.

Much of the equipment in the machine shop has been removed. It no longer has any traveling cranes; however, the crane columns and rails still remain. The rails in the older section of the shop are riveted, while the metal and electrical shop's rails are welded. Several pieces of the original machinery, too heavy to remove easily, still remain in the machine shop. These include: an Ingersoll-Rand air compressor, a Davis

Key Seater from Rochester, three lathes manufactured by Pond Machine Tool Company of Plainfield, New Jersey, Bennett-Raffin Machine Company of Jersey City, and American Tool Works of Cincinnati, and several smaller pieces of equipment. A small forge is still evident in the metal shop area.

## The Crushing Mill

Kekaha Plantation Company's crushing mill runs perpendicular to the cleaning plant, in a north-south direction. It sits at ground level on a concrete slab foundation and features an over-lapping, gable roof. This mill train and its enveloping structure were fabricated by Honolulu Iron Works and installed in 1954. It supplanted a seventeen roller mill which ran east-west in the area now occupied by the eastern end of the machine shop. At the time of its construction, it was the longest and heaviest mill in the territory. The one-hundred-foot-long tandem with seventeen 38" x 78" rollers was capable of handling 125 tons of cane per hour. Powered by six 450 hp multi-stage steam turbines, it was the first steam turbine-powered crushing mill in Hawaii. It was also revolutionary as the entire mill train was electronically controlled from a central station by one person.

The mill train and its steam turbines occupy the south three-quarters of the mill wing. Two sets of steps, one with eleven treads, the other twelve, lead from the concrete floor up to a metal platform with a diamond plate metal floor which services the turbine area. Another set of steps, with nine treads, ascends from the turbine level to a metal platform with a welded rebar and press-locked welded bar grating floor which services the mill train.

The portion of the conveyor that brought the cane from the cleaning plant to the mill is no-longer-extant, and the knives, Krajewski crusher, and shredder have also been removed. However, the 1200 hp General Electric steam turbine that powered the crusher remains in place as do the five three-roller mills and their turbines. The mills are all equipped with hydraulic rams and have force feed rollers, which were added in 1957, which greatly reduced choking, a primary cause of mill stoppages. Each of the five mills has three large cylindrical rollers that measure 34" x 78". There are two lower rollers, the first called the "cane or feed roller" and the last the "bagasse or discharge roller" with one roller on top. These rollers have Messchaert grooves. Developed in 1913 by P.A. Messchaert, the mill superintendent for Oahu Sugar, these grooves in the surface of the rollers were somewhat deeper and wider than other rollers then in use and they greatly reduced slippage as the cane passed through them and improved extraction of juice. Between the first and second mills is the control panel which operates the entire mill. A macerator is situated after the second mill. At the end of the mill a bagasse carrier removes the bagasse to either the bagasse storage building or directly to the boilers.

The five mills are each powered by a 450 hp multi-stage steam turbine. Western States high speed and low speed gears reduce the turbines' approximately five thousand rotations per minute (rpm) down to the five rpm at which the mill rollers turn. The turbines are situated to the east side of the mill tandem and at a lower level. Five metal steps lead down from the mill train's platform to the level where the large, low speed gear boxes sit on their raised concrete foundations. One concrete step lower the high speed gear boxes are situated, and two concrete steps below these gear boxes are the steam turbines.

The mill train is housed in a 58' x 200' structure that rises to a height of 58 feet. The structure is carried by 18" steel I-beam columns which support the 12" I-beam roof rafters, which, in turn carry the roof's steel purlins and corrugated metal roof. The west side has no walls, being open to the boiling house and machine shop and the north side is likewise open to the outdoors. Both the east- and south-facing walls are enclosed by corrugated metal walls. The structure is ten bays long, with each bay defined by the I-beam columns. The two northern-most bays shelter the terminus of the cleaning plant and have no windows, while the third bay serves as a passageway, with its east wall open to the outdoors and its west side leading directly into the machine shop. On the first story, the east wall has a pair of fenestra steel windows in each of the six southern-most bays. These windows are composed of two pivot windows of six panes each, one above the other, separated by a set of three fixed lights and also framed at top and bottom by three fixed lights. The south end of the wing is three bays wide, and has similar fenestration on the first story. In addition, in the gable's peak there are three sets of six-pane fixed windows. In the bay closest to the boiling house there is a set of three metal louvers situated immediately above the bagasse conveyor.

A traveling crane, with an operator's cage suspended underneath it, services the mill tandems. The crane rails are supported by the building's structural I-beams.

## Boiling House

The boiling house is located on the west side of the crushing mill and south of the machine shop, and sits under four gable roofs, all of which have monitors. Its operations are housed on two floors, with the centrifugals, and the bases of the clarifiers and evaporators standing on the ground floor. The clarifiers and evaporators extend up to the second floor, where the heaters, mud filters, evaporator pans, and crystallizers are also situated. The boiling house is an L-shaped space, measuring approximately 58' x 260' with an approximately 60' wing extending to the west from its northwest side. Windows penetrate the boiling house walls on its upper stories with exterior faces. The placement and present condition of the windows will be discussed when the various interior spaces are addressed.

The boiling house sits on a concrete slab foundation, which supports the steel superstructure with its 8" I-beam columns sitting on square concrete footings. At the ground level the boiling house is enclosed by either corrugated metal walls without windows, or abuts one of the mill's many additions, or is open to the outside.

The boiling house, on the east, opens on either the crushing mill or the outdoors, while the north side opens to the machine shop and is elevated one 18" concrete step above the machine shop floor. In this area, the bases of the three clarifiers and six long tube evaporators sit on the ground floor. The three clarifiers define the north-west section of the boiling house. They sit in a row along an east-west axis and were made by three different manufacturers, with the Seip the furthest west, followed by a Petree-Dorr and then a Garver. The Seip Clarifier was installed in 1940-41. It sits on a 4' high concrete foundation, which has a metal door which accesses the bottom of the clarifier and a storage area. A ladder runs up its side and five small, round windows, known as sight glasses, penetrate the clarifier's side at different levels, enabling technicians to observe the contents of the clarifier. It is sheathed in wood slats encircled by a steel band. The five-compartment, 18' diameter Petree-Dorr has a 26,500 gallon capacity and dates from 1931. It sits on a 6'-6" reinforced concrete foundation with a tunnel extending through its diameter to access the bottom of the clarifier. The Garver sits on a 6'-6" metal base and has corrugated metal sides. The base has a door, which opens to reveal a storage space, as well as the bottom of the clarifier. Both the Dorr and Garver clarifiers have four sight glasses running up their sides. The Garver clarifier was acquired in 1957.

South of the clarifiers, directly below the second floor heaters, is a large, raw juice storage tank, which holds the sugar juice until it is sent to the scales. To the east of the clarifiers are six Birmingham, long tube, film type, juice evaporators with vapor heads. These are placed in two rows of three each, oriented on a north-south axis. They are framed and supported by a staging whose primary structural members are 10" I-beam columns spaced between 10'-2" and 13'-2" apart. The six all-steel evaporators measure 11'-6" in diameter, and 45'-7" from the boiling house ground floor to the top of their save-alls. Inside they contain 24' long, 2" in diameter, 12 gauge stainless steel tubes with between 535 and 580 tubes in each of the six evaporators, providing 6,000 square feet of heating surface. The main bodies of the evaporators, containing the tubes are 6' in diameter, while the vapor heads measure 11'-6" in diameter.

The Kekaha Mill was the first cane sugar mill known to employ long tube evaporators, which had been used for years in paper mills, and also employed in a beet sugar factory in Woodland, California. Management as Kekaha Sugar Company found the all steel long tube evaporators attractive, as they were 20 to 30 percent cheaper than cast iron, copper and muntz metal evaporators, and they required less floor space, only 27'-7" x 40', allowing them to be installed during the grinding season without interruption to production. In addition, their all-steel construction made changes and repairs easier to accomplish. The long tube units carried a very small quantity of juice per unit, so the cells had to be maintained in a careful balance or evaporation noticeably slowed down. Because of this need for balance, automatic controls were installed for the evaporators after several seasons. The evaporators are a series of tanks which boil off excess water to convert the sugar juice into syrup. Depending on the number of tanks, or cells, employed, the series of evaporators are called triple, quadruple or quintuple-effect evaporators. For many years Kekaha Mill had quadruple-effect evaporators, but eventually converted to quintuple-effect, which in recent times is the industry standard. In this arrangement the first three evaporator tanks serve as the first cell, with the fourth, fifth and sixth long tube evaporators employed as cells two, three and four. The fifth cell is a pair of calandria-type evaporators, which are situated on the second floor.

To the south of the evaporators the ground floor of the boiling house is characterized by relatively large open spaces, containing various types of equipment placed at irregular intervals, all of which provide support for different mill functions. Much of the piping runs overhead that is used to transport sugar juice, massecuite, steam, and condensed water to various destinations. South of the evaporators there are four 46' x 30' electric drive Roberts high grade centrifugals, which date from 1959. They are elevated above the ground by a stainless steel staging that runs in an east-west direction and are fed from above by a header, a large pipe, which is located above the centrifugals. The staging supports a platform with a diamond-pattern steel plate floor from which operators could adjust the centrifugals' control panels. Seven steps lead up to the platform. Next to the high grade centrifugals is the cup elevator which transported the processed sugar crystals up to the conveyor which took it out of the mill on a covered 20" wide belt to the sugar bin.

The four-hundred-ton sugar bin stands to the east of the mill and has a dirt road which passes underneath it to allow trucks to load sugar for transport to the pier. The free standing bin is 50'-7" high and 28' in diameter. It was fabricated by Honolulu Iron Works in 1950, being installed as part of Kekaha Sugar Company's conversion from bag to bulk sugar handling. The 20' high cylindrical tank has a shallow, truncated domed roof with a 3-3/4 in 12 slope. Four hooded side vents project from the surface of the tank near its top. At the bottom the tank tapers to a point with two 18" wide discharging gates. The bin is supported by six 18" I-beams tied together by two sets of six 20 gauge, 6" steel channels. The first set is 12' above the ground and the other 10'-3" above the first. Cross braces of 10" x 10" angle iron between the channels provide further structural support. The support structure forms an irregular hexagon, with the two sides through which the trucks enter and exit being 18' in width, while the other four sides are all 11'-10". Originally a ladder, whose rungs were welded to one of the frame's I-beams, provided access to the top of the bin. A more recently-installed straight run of steps now leads up to a hexagonal shaped platform that skirts around the bottom of the bin.

Several other structures are located outside the confines of the mill on its east side. Three large, cylindrical, metal tanks stand in a row south of the sugar bin. The two closest to the sugar bin store molasses and the third is a fuel oil tank. The northern-most molasses tank dates from October 1972, and holds 92,124 gallons of molasses. The tank is 24' in diameter and stands approximately 23" high to the peak of its cone shaped metal roof. The second molasses tank has a 24' diameter and rises 20' in the air. It has a 67,700 gallon capacity. A smaller cylindrical feeder tank is mounted on its side on top of this tank. The fuel oil storage tank was installed in 1949. At the time of its acquisition, E.F. Shackelton, the mill's office manager, noted that it was "built either by or for the U.S. Navy, having been installed when new at Pearl harbor and used there, and is now in first class condition." [letter dated May 20, 1949, from Shackelton to American Factors Insurance Department] It has a 51,744 gallon capacity and stands approximately 22' high with an approximate 12' diameter.

To the east of the sugar bin, on the other side of the ditch which runs through the mill property, is the seed treatment plant which dates from circa 1975. Sugar cane "seeds" are segments of sugar cane stalks. Prior to being planted they subjected to a hot water bath at 117 degrees to eliminate any insects or bacteria. The seed treatment plant is a pair of concrete troughs that are 7'-4" deep with a 3" thick, and 7" wide iron cap. The walls are 4' above ground. Each bay measures 8'-6" in length and is demarcated by a 4' high and 14' wide pier. The cleaner is nine bays long and is divided into two troughs, each consisting of four bays, with the center bay functioning as a divider and a housing for the cleaner's temperature controls.

Above the concrete troughs is a metal super structure, constructed of 6" I-beams placed on the four corner piers and the four middle piers that support 12" I-beams with diagonal bracing. In addition, on the *south* side, additional support columns rise from the third and eighth piers. Suspended from this super structure are cast iron trays with a platform made of steel press locked welded bar grating above. The trays and grating are connected by tie rods, and the entire unit is raised or lowered by way of roller chains. At the bottom of the troughs are stainless steel tubing. Three tire guards in each trough protect the concrete walls from the iron trays. The seed treatment plant was modeled after a similar structure at Puunene.

Returning to the interior of the boiling house, to the *south* of the high grade centrifugals are a cylindrical tank with an open top and a square bin with a four sided, pyramidal chute at the bottom. The functions of these two free standing elements are unknown. Beyond these two mysteries are the low grade centrifugals. A steel staging runs in a north-south direction and is accessed at the north end by fourteen steps made of welded rebar. Originally the staging supported five centrifugals, but the middle one has been removed. The two centrifugals south of the vacated space are Roberts, while the two centrifugals on the north end have no identification plates. A header feeds the massecuite into the centrifugals, while below the machines a worm conveyor with a hopper at its terminus handles the finished product. In front of the clarifiers, on the east side, is a long, thin, cylindrical molasses tank and next to this is a squat cylindrical syrup tank, both of which were used for storage when slow downs occurred. Next to the syrup tank is a syrup pump, and south of the molasses tank is a massecuite pump that returns the centrifugals' molasses back to the crystallizers in an effort to obtain additional sugar.

The centrifugals are located on the ground floor below the crystallizers. This part of the boiling house extends out beyond the crushing mill and is open to the outdoors on its east side. A single story shed roof protects a concrete apron on this side. The shed roof is supported by six Pratt trusses. Outside the boiling house, in the corner where it intersects with the crushing mill's south terminus, is the lime house. This uncovered area includes four tanks and a steel platform. Here the lime was stored and mixed prior to being added to the sugar juice.

On the ground floor, west of the low grade centrifugals, the factory laboratory runs along the west wall of the boiling house. This single story, flat roofed, sheet metal building is 12' high, approximately 92' long, and 15' deep. It is divided into seven bays, with each bay demarcated by the laboratory's six-inch I-beam-framing members. Doorways access the laboratory in the second, third and fourth bays. The laboratory is broken into discrete spaces, with a large open laboratory with sinks and formica cabinet tops in the two southern-most bays. The third bay held offices, and the remaining part of the building was devoted to various laboratories.

Thirteen steps lead up to a mezzanine that is situated above the laboratory. At the head of the stairway is an opening with a catwalk that connects to the boiler house. The mezzanine has three rooms at its south end. To reach the southern-most room, you must pass through the other rooms, as there is no connecting corridor, only the doorways between the rooms. The rooms range in width from 12'-5" to 13'-9", with the smallest sitting to the south of the others.

## Boiling House Second Floor

From the ground floor a flight of thirty welded rebar steps, located at the west end of the boiling house, lead up to the second floor. At this level there are the scales, heaters, mud filters, pans, and crystallizers, as well as the tops of the clarifiers and evaporators. The floor is reinforced concrete, and the L-shaped space sits under four different gable roofs all with monitors. The roofs are supported by Fink trusses, and the entire superstructure is carried by 8" I-beam columns.

The wing that forms the foot of the L-shaped floor plan is four bays long, with its roof running in an east-west direction. The head of the stairs from the ground floor to its right is illuminated by a six-pane pivot window with three fixed panes below, set in the west wall of the boiling house. To the left of the stairs are four heaters, arranged in a row, moving west to east. The western-most heater is a Silver with 1,982 square feet of heating surface and one and one half inch diameter tubes. It is the primary heater, and dates from 1973. A secondary vapor heater manufactured by Honolulu Iron Works in

1956 is to the east of the Silver. The number three vapor heater is a 1982 Lucas with 770 square feet of heating surface, which also served as a secondary heater. The number four vapor heater is a morphodite, a Bundaberg with 2,250 square feet of heating surface. Acquired in 1986 it is characterized by distinctive circulatory ends.

South of the heaters are two stainless-steel tanks, each on its own metal staging with five steps. Here the mill workers mixed the caustic soda used to clean the evaporator and heater tubes. To the west of the caustic soda tanks is a shower-eye wash station. North of the heaters are the tops of the Dorr and Seip clarifiers. A clarifier flash tank sits above and between the Dorr and the Seip clarifiers, while a prominent worm gear extends above the top of the Dorr. North of the clarifiers is a rather recent boiling house office constructed of T-111. The flat-roofed office is 32'-2" long x 15'-1" wide. There are two rooms in the office which are inter-connected by a door. Two doors, one in the east-facing wall and the other in the south-facing wall, access the east room from the mill. This room has a plate-glass window in its east wall and three similar windows in its north wall that look out into the machine shop. The second room is entered through an aluminum sliding-glass door on its west side. The sliding door has been removed, although its frame remains intact.

A pair of 20,000 pound capacity Fairbanks raw juice scales and their tanks sit in front of and between the Dorr and Garver clarifiers. Southeast of the scales is a square hole in the floor with a pipe railing around it. Twelve steps descend down into this well, where a thin juice evaporator supply tank is situated. This tank was necessitated by the fact that the long tube evaporators could not be used for storage.

South of the scales are three Oliver mud filters set in a row running north to south. Two measure 8' x 9' and the third is 8' x 12'. The Oliver mud filters were developed during the 1920s and manufactured by Oliver United Filters Inc. of Oakland, California. They were the most efficient means of recovering the sugar remaining in the sediment after clarification at the time of their installation at Kekaha Mill. The Oliver Filters are large, slow-revolving cylinders surfaced with a fine mesh copper screening. The drum circulated through a bath of sediment-filled juice, to which bagasse was added. An intricate inner system of tubes produced a powerful vacuum that sucked the juice through the screens, leaving the filter cake affixed to the screening. A scrapper bar removed the cake from the screen.

Immediately north of the middle filter are a pair of receiver tanks, which are set down into the floor with only their tops exposed. One measures 34" diameter by 60" high, while the other has a 23" diameter and is 60" high. These tanks collected the juice that was retrieved by the mud filters. From the receivers, the juice is pumped to either the evaporator supply tank or the clarifiers. In 1954 a new 12" wide conveyor was placed under the floor below the filters to transport the excess mud from the mill. Between the middle filter and the southern-most filter is a cyclone feeder, which delivered bagasse down to a short conveyor that carried the bagasse to where it was added to the mud mix in the Oliver filters.

To the west side of the mud filters the boiling house is open, with a pipe railing that overlooks the former boiler room. At some point after 1955, the former boiler room was converted into the electric shop. East of the mud filters are four, calandria-type vacuum pans, numbered 3, 2, 4, and 5, each of which are served by an individual condenser. Numbers 4 and 5 operated as low grade pans, while 2 and 3 were either low or high grade, depending on the need. All the pans have eye glasses, or lunettes, through which the progress of the boiling liquid could be observed and all have save-alls mounted on their tops. Between the southern-most Oliver filter and the Number 4 pan, there is a straight run of thirty metal steps which descends to the ground floor.

To the east of the four vacuum pans, there are two sets of four steps which lead up to a platform where two high-grade, calandria-type vacuum pans, numbers 1 and 1A, are situated. They both have eye glasses, or lunettes, through which the progress of the boiling liquid may be observed and have save alls mounted on their tops. Number 1A is the newest of the pans, having been installed in 1956. This 14'-9" high x 17'-9" diameter pan was fabricated by Honolulu Iron Works. Between the two pans, there is a cup elevator that transported the sugar up to an overhead conveyor that took it to the sugar bin. These three objects are protected by their own roof, which consists of a short east-west oriented gable roof with a monitor running its length, which connects the crushing mill and the boiling house. The east end of this part of the boiling house is open and overlooks the interior of the crushing mill.

Also from this level the vapor heads of the six long-tube evaporators are accessible, as well as evaporators 5A and 5B, which served as the fifth cell of the quintuple-effect. Evaporators 5A and 5B are short-tube calandria-type evaporators with a cast iron shell, steel tube sheets and 2" copper tubes. They were fabricated from pieces of the evaporators which were replaced by the long tube evaporators. The calandria for these two tanks were replaced in 1984. On the east side of these two evaporators stands a large condensate tank.

South of the high grade pans, seven metal steps lead up to a platform that traverses the length of the rectangular syrup and molasses tank. A set of twelve steps also leads up to this platform from the low grade vacuum pans. This large metal tank is divided into six compartments. The two north compartments store the syrup, while the middle two are labeled Molasses A and the two south sections hold Molasses B. Over the syrup tanks the 70'-high roof, which runs in a north-south direction over the boiling house, comes to an end, at which juncture the lower, 57'-6"-high crystallizer wing commences.

The roof over the crystallizer wing of the boiling house, which is lower and slightly wider than the main body of the boiling house, measures 68'-6" x 116'. The centrifugals are located on the ground floor, and the crystallizers above them on the second floor. On the second floor, nineteen crystallizers are mounted on steel frames above the floor. A metal stair with eighteen steps leads to a pair of catwalks to serve the crystallizers, allowing mill staff to look inside the open tops at the massecuite. Each crystallizer is rectangular in plan and has a half cylinder cross-section with a powerful spiral stirrer on a rotating cam shaft, a development that occurred in the late 1930s. Originally the crystallizers had flat broad-bladed stirrers, but these were replaced with the present tube stirrers which allowed the massecuite to be heated or cooled by running either hot water or cold through the tubes. The crystallizers are all riveted. At the upper-most observation level a massecuite heater sits above the crystallizers. It was manufactured by Power Max Engineering of Australia. Along the west side of both the boiling house and crystallizer wing, second-story six-pane pivot windows are framed by twelve fixed panes, which provided light to this part of the mill.

**Boiler House**

The boiler house sits in a wing that is south of the electrical shop and west of the boiling house. This wing represents at least three distinct building episodes, as reflected in its roof configurations. The oldest of the sections dates to 1947. It sits north of the others, measures 62.5‘ x 144‘, and is sheltered by a 55’-8” high, corrugated-metal, gable roof with a monitor that runs in an east-west direction, and contains eight bays. Each bay is delineated by a Fink truss carried by 8” I-beam columns. All four sides are open and lead to the boiling house to the east, the boiler wings to the south, the outside to the west, and the machine shop to the north. Originally all the boilers were housed in this section, but now only one, long-defunct boiler occupies the western-most two and a half bays, with the remainder of the space utilized by an electrical shop and the boiling house. The two-floor-high boiling house occupies the two eastern-most bays and its concrete ground floor is elevated four steps above the concrete floor of the space occupied by the electrical shop and boiler. The 11’ high, riveted metal boiler sits in and on a brick furnace that measures 14’-7” x 18’ and raises 15’ from the floor of the boiler house. The brick furnace is framed by 8” and 12” I-beams and 22 metal steps lead up to a service platform for the boiler. A condensate tank adjoins the boiler and is supported by a pair of 18” I-beams that sit on 20” high battered concrete footings that measure 20” x 38” at their base. At some point, a pair of Enco Oil burners were added to the furnace at its lower level and intended for situations when there was insufficient bagasse to feed the furnace.

In addition to the boiler, this area also holds an Ingersoll-Rand reciprocating air compressor powered by an Allis-Chalmers 75 hp motor, and a square metal tank, open on the top, which stored water for the stack’s sprayer, which was used to reduce the dispersal of ash into the atmosphere.

Leading off of the original boiler house are two wings running in a southerly direction. The first was constructed in 1949 to accommodate a new boiler, and the second was constructed between 1953-1955 to house a tangentially-fired boiler, which supplanted all the previous boilers and remained in operation until the mill closed. The 1949 boiler wing is 54‘ x 62.5‘ in size and is sheltered by a corrugated-metal gable roof with a monitor that runs in a north-south direction. This wing has three bays, each of which is delineated by a Fink truss supported by 8" I-beam columns. Its height is 55'-8", and it is open on all four sides, with a partial corrugated metal wall partitioning it from the 1955 boiler house wing on the ground floor. It holds a boiler similar in design to the boiler in the original boiler house, with a brick furnace surmounted by a metal boiler. At the ground level the brick furnace's front face is penetrated by three sets of cast iron, double Dutch doors with each half measuring 24" x 31". Twelve metal steps lead up to a 5'-10" high mezzanine level where three segmental arched, cast iron doors access the brick furnace. A metal stair with eighteen treads continues the straight run stairway from the ground floor, leading to an upper level where three bagasse chutes remain intact and the riveted metal boiler is situated. The three furnaces have step grates on the interior.

The 1955 wing has a concrete slab floor and its steam generator rises to a height of 69'-6". The wing is entirely comprised of the tangentially-fired boiler and its supporting equipment, including the metal stairways, platforms and catwalks which service the device. There are no sides or roof. On the ground floor at the north end of the wing are four water pumps, three steam-operated and one electric, which pumped water to the boiler. The western-most steam pump was manufactured by Worthington. Outside the superstructure, on the east side, in a space between the steam generator and the boiling house, are two large condensate tanks each holding 75,000 and 50,000 gallons capacity respectively, as well as two smaller water supply tanks. A partially dismantled metal stack stands on the south end of the wing. This was built in 1954 in anticipation of the completion of the new boiler and was constructed of two surplus 10' x 40' tanks which were mounted end on end. It eventually proved to be ineffective as it spewed ash over the surrounding community, and it was taken out of use in 1989 and partially dismantled, with only one 40' high section remaining. In its stead the older, 205' brick-lined, concrete stack built in 1931 was placed back in use. This stack sits on the west side of the 1947 boiler house wing. In 1989 it was retrofitted with a scrubber with a fine mist sprayer in order to better control air quality.

North of the stack in an open area behind the machine shop, an air compressor shed was constructed in 1968. It houses a large Ingersoll-Rand air compressor. Designed by the mill's Factory Department, the simple, utilitarian building measures 10' 8" x 18'-8" and sits on a reinforced concrete slab. It has corrugated metal walls and a similarly clad shed roof, structurally supported by 2.5" x 2.5" quarter inch thick angle iron studs and rafters. Its shed roof slopes at one and an eighth in twelve, with the east wall being 8' tall, while the west side measures 9' in height. A metal, double doorway, 7' high and 5'-1" wide, is centered on the south elevation and accesses the building. The west side features a clerestory comprised of three sets of four screens, which provide ventilation to the shed.

**Mezzanine Floor: Power Generating Plant**

The 72' x 57' power generating plant is situated on a mezzanine above the electrical shop area. Two sets of metal stairs, each with twenty-two steps, lead up to the mezzanine floor on its mountain and ocean sides. Both are straight runs, with the former ascending in a north-south direction, with a landing between the tenth and eleventh treads, and the latter ascending in a west to east direction. The power generating plant, as well as off-site hydro-power plants at Waiawa and Waimea, not only provided electricity for the sugar mill, but the entire plantation, including the irrigation system and workers' housing. The power generating plant was added to the mill in 1930, when a Westinghouse, 1500 KW steam turbine generator was installed. It was supported on the ground floor by a Westinghouse surface condenser with 1,775 square feet of cooling area. This generator is no longer present; instead there are three General Electric turbine generators, placed in a row in the middle of the room. The two G.E. 2500 KW generators are intact, and the third, 2400 KW generator, is in pieces. The two 2500 KW generators date from 1950 and 1960, with latter having been purchased second hand in Nevada. The generators' steam turbines were powered by high pressure, four hundred pounds per square inch (psi), steam, which over the course of turning the turbines got reduced to fifteen psi by the time it was sent to one of the three condensers located on the ground floor beneath the generators. At the end of each generator is an exciter. Each generator also had a steam ejector, which facilitated the starting of the turbines, reducing the start-up time from four hours to one half hour by pulling a vacuum in the compressor. The two 2500 KW generators had Worthington steam ejectors, while the dismantled 2400 KW machine was served by an Ingersoll-Rand steam ejector. These stand along the south wall of the power generating plant. A traveling crane beam serviced the generators, and sits on tracks, supported by 6" I-beams placed 14' on center.

The power generating plant is a lofty, 70'-6" x 66'-6" room with a reinforced concrete floor and a 57' high open ceiling. Fink trusses of seven panels with king posts and braces support the gable roof and its monitor. The room is four bays long, with each bay defined by a roof truss carried by 8" I-beam columns situated alongside, but outside, the walls of the power generating plant. It runs in an east-west direction. The west-facing, corrugated metal wall is the only one to have windows. The five sets of windows in that wall include three, six pane casement windows framed by three pane side lights, interspersed with two awning windows, each of six panes, framed by seven lights on the bottom and sides.

Control panels line the north and east walls of the room. A flat roofed office, constructed of T-111, is situated near the middle of the north wall. It measures 8' x 10' and stands 9' high. Its centered door is flanked by plate glass windows which look out upon the power generating plant.

The power generating plant was shut down in 1998; however, the transformers located outside the mill at ground level are still being utilized in the operation of the plantation's former irrigation pumps. This use will be terminated in the spring of 2009, when Kauai Electric makes its own new system operational.

Below the power house on the ground floor are located the three condensers, two of which were manufactured by Worthington. These are set in heavy concrete foundations which frame this equipment.

## SOURCES

Original Drawings:

Approximately one hundred original drawings and blue prints for the Kekaha Sugar Company's sugar mill and its machinery exist. These abandoned drawings were discovered in the mill office, and are incomplete. The plans will be deposited in an appropriate repository, which has yet to be determined. The following drawings provided information for this report.

| **Title & Sheet #** | **Date** | **Office in Title Block** | **Drawn by** | **Drawing Number** |
|---|---|---|---|---|
| 23" x 60" Receiver | May 16, 1925 | Oliver Continuous Filters | F.L. | 33A725BS |
| Proposed Power Plant | Dec 4, 1929 | W.A. Ramsay | W.E. Melarkey | 2912067 |
| 34" x 72" Receiver | Dec 28, 1929 | Oliver United Filters Inc. | G.L. | 34A72SS |
| Dorr Clarifier | Sept 16, 1931 | Petree and Dorr | S.S. | 2185 |
| Cane Washer | Dec 26, 1938 | | | |
| Fire Protection System | June 25, 1941 | Civil Eng & Survey Department | | 383 |
| Mountain End View of Heater | Dec 7, 1942 | Mechanical Equipment Department | | |
| Rotary Trash Remover | June 7, 1943 | Mill Engineering Department | McAllister | |
| Combing Drums and Trash Remover | Oct 26, 1943 | Kekaha Sugar | McAllister | |

| | | | | |
|---|---|---|---|---|
| Combing Drums and Trash Eliminator | Dec 5, 1943 | Kekaha Sugar | McAllister | |
| Cane Cleaner, Trash Gap and Rock Bath | Dec 1943 | Kekaha Sugar | C.H.Mc | |
| Floor Plan, Laboratory | n.d. | | | |
| Section and Elevation of Machine Shop | n.d. | | | |
| Evaporators | Aug 30, 1946 | Goslin-Birmingham Mfg. | | |
| Watchman's Route | June 26, 1947 | Kekaha Sugar | | |
| Fuel Storage Tank | June 2, 1949 | Factory Department | | |
| Waste Molasses Scale Tank | Feb 10, 1950 | Factory Department | George Ching | 1 of 1 |
| Fire Protection System | July 8, 1950 | Civil Engineering and Survey Department | | 383 |
| Circulating water for Turbo Generator | Aug 21, 1950 | Factory Department | George Ching | 1 of 2 |
| 400 Ton Sugar Bin | Sept 19, 1950 | Honolulu Iron Works | | 48-299 |
| Plan and Elevation for Laboratory Structure | Apr 30, 1951 | Factory Department | George R. Webster | |
| Crusher and First Carrier | Nov 6, 1951 | Factory Department | Robert Onzuka | |
| Mill Number 1 | June 26, 1952 | Western Gear Works | F.A.S. | N-717 |
| Mill Building for Kekaha Sugar | Sept 16, 1952 | Honolulu Iron Works | | 206-238 |
| Extension to Steel Frame for 20' Wide Belt Sugar Conveyor | Aug 15, 1952 | Honolulu Iron Works | | 48-211 |
| 150,000 Pound Steam Generator Plant | May 3, 1954 | Factory Office | R.O. | 1 of 3 |
| Erection and Sheeting Plans for Mill Building | April 26, 1955 | Honolulu Iron Works | | 206-279 |
| Location Plan for Vacuum Pan | Feb 24, 1956 | Honolulu Iron Works | | 35-938 |
| Layout of Four Centrifugals | Sept 25, 1959 | Western States Machine Co. | F.W.M. | E-4102A |
| Bagasse Handling System | May-June 1964 | Link-Belt Co. | | FK643 4 |
| No. 2 Reclaim Conveyor | May 30, 1966 | | J.K. | |

| | | | | |
|---|---|---|---|---|
| Feeder Chute | | | | |
| Schematic Diagram, Boiling House | Sept 22, 1966 | Kekaha Sugar Co. | | |
| Evaporator Station Alterations | Nov 13, 1966 | | | K-1 |
| Two Stage Compressor Building | Nov 6, 1967 | Factory Department | J.R. | CC-694 |
| Safety Stair Tread | June 1968 | Grip Strut | JAB | 1 of 7 |
| Fire Protection System | July 22, 1969 | Factory Department | J.R. | |
| Cleaning Plant Arrangement | Mar 31, 1970 | Factory Department | J.R. | |
| 26” x 78” Force Feed Roll | March 24, 1971 | Factory Department | J.R. | C.C. 310 |
| Molasses Tank | Nov 1, 1972 | Honiron | JP Jr | 59-129 |
| Factory Shop Layout | Jan 11, 1974 | Factory Department | J.R. | |
| Boom, Cane Unloader | Oct. 22, 1975 | Factory Department | | |
| Flo-Bin, Quick Lime | Apri 15, 1976 | Factory Department | W. Abara | |
| Lifting Hook Details | Sept 9, 1977 | Factory Department | J.R. | M-1 |
| Cane Cleaner | Jan 15, 1979 | Kekaha Sugar | R.I. | |
| Unloading Station | Feb 20, 1980 | Agriculture Group | E.E. | A |
| 1A Boiler Bagasse Feeders | April 25, 1981 | Factory Department | J.M. | |
| 770 Square Foot Primary Juice Heater | Mar 24, 1982 | Lucas Engineering | SAL | 72-723 |
| Crystallization Modification | Dec 31, 1982 | Lucas Engineering | L.M. | 72-938 |
| Turbo-Generator Foundation Layout | March 9, 1984 | Factory Department | J.M. | 1 |
| Profile, New 5A and 5B Evaporators | April 4, 1984 | | | 1 of 2 |
| Gnrl Arrangement Centrifugals | May 3, 1984 | Factory Department | J.K. | 556 |
| Layout of (2) CC6 Centrifugals | Sept 9, 1984 | Western States Machine Co. | Williams | 080-0148-00-4 |
| Juice Heater | May 11, 1985 | Bundaberg Foundry | H.F. | B1-141-273 |

| | | | | |
|---|---|---|---|---|
| Alteration of Shredder Supporting Columns | June 24, 1986 | | | 1 of 3 |
| Automotive Shops Layout | June 7, 1988 | Kekaha Sugar | | |
| Fire Protection Plan | Feb 17, 1988 | Factory Department | J.K. | |
| Smoke Stack Platform | Aug 18, 1989 | | J.K. | S-3 |
| Scrubber Spray System | Sept 11, 1989 | Kekaha Sugar | J.K. | MJS-P1 |
| Scrubber Spray System | Sept. 11, 1989 | Kekaha Sugar | J.K. | 10818-5 |
| No. 1 Rock and Mud Conveyor Modifications | Dec 7, 1994 | Factory Department | J.K. | Sheet 1 of 9 |
| Head End Sectionals of No. 1 Mud and Rock Conveyor | Jan 13, 1995 | | J.K. | Sheets 2, 4, and 5 of 9 |
| Cane Unloading Station, Various Hook Modifications | Dec. 14, 1995 | Thermal Engineering Corp | TEC | M2 |
| Cane Unloading Station | Mar 11, 1997 | Thermal Engineering Corp | RKS | M 1-4 |

In addition, the Kauai Historical Society has a collection of drawings and maps that pertain to the Kekaha Sugar Company's mill. The following provided useful information:

| Title & Sheet # | Date | Office in Title Block | Drawn by | Drawing Number |
|---|---|---|---|---|
| Watchman's Route map | Feb 17, 1940 | Kekaha Sugar Co. | C.S. Koike | No. 288 |
| New Washing Plant sketch | Mar 18, 1941 | Kekaha Sugar Co | | |
| Service Station blueprints | 1955 | Kekaha Sugar Co | | |

Kekaha Sugar Company Records:

The Hamilton Library at the University of Hawaii at Manoa serves as the repository for the Hawaiian Sugar Planters' Association's (HSPA) Plantation Archives, and includes approximately 62.5 cubic feet of materials pertaining to the Kekaha Sugar Company collection. The following files provided useful information:

KSC 0-2/20: Power House Map

KSC 0-2/24: Fire Protection Map, 1937

KSC 1/7: Government Lease, 1916-1937

KSC 2/11: Blueprints

KSC 3/5: Correspondence from Hackfeld, 1886

KSC 8/3: Correspondence from Hackfeld, 1913-1914

KSC 9/2: Correspondence from Hackfeld, 1916

KSC14/1: Correspondence from KSC, 1895-1898

KSC 18/5: Specifications of Mill Machinery, 1899-1923

KSC 19/4: Correspondence from Amfac, 1904-1919

KSC 19/12: Allis Chalmers, 1906-1912

KSC 19/15: Correspondence from Baldwin, 1921-1927

KSC 19/21: Boilers, 1920-1937

KSC 19/23: Bureau of Boiler Inspection, 1920-1925

KSC 19/24: Correspondence, 1917-1927

KSC 19/27: Catton, Neill & Company, 1895-1923

KSC 19/37: Correspondence 1921-1927

KSC 19/38: T.H. Davies, 1917-1927

KSC 19/39: T.H. Davies 1928-1934

KSC 20/2: Electric Power, 1922

KSC 20/3: Evaporators, 1928-1936

KSC 20/22: photos, mill machinery

KSC 20/24: Hawaiian Electric, 1919-1927

KSC20/25: Hawaiian Electric, 1913

KSC 21/4: Honolulu Iron Works, 1885-1899

KSC 21/5: Honolulu Iron Works, 1901-1911

KSC 21/6: Honolulu Iron Works, 1912-1918

KSC 21/7: Honolulu Iron Works, 1919-1927

KSC 21/8: Honolulu Iron Works, 1928-1936

KSC 21/23: Insurance, General 1929-1936

KSC 21/28: Jackson Iron Works, 1915-1922

KSC 22/12: Proposals and Quotes from Companies, 1929-1930

KSC 22/5: Mill & machinery, 1899, 1916-1917

KSC 22/11: Perine Machinery Co., 1928-1930

KSC 22/13: Pumps, 1929-1937

KSC 22/15: Correspondence, 1927-1936

KSC 22/26: Turbo-Generator, 1929-1936

KSC 22/29: Vacuum Pan, 1928-1935

KSC 22/33: Blueprint

KSC 23/11: Centrifugals, 1930-1937

KSC 23/12: Chimney, 1930-1936

KSC 23/17: Electrical Department, 1931-1936

KSC 23/21: Factory, 1933

KSC 23/23: Filter, 1930-1935

KSC 24/11: Mill Machinery, 1933-1935

KSC 25/17: Boiler Inspection

KSC 25/20: Building Specifications

KSC 25/24: Cane Cleaning Equipment, 1938-1944

KSC 25/33: Construction, 1937-1945

KSC 26/6: Photos of Equipment, Tools

KSC 26/15: G. Correspondence 1939-1941

KSC 26/19: Hart Wood 1937-1939

KSC 26/29: HSPA, Labor Saving Devices Communication, 1938-1939

KSC 27/7: Insurance, General, 1936-1938

KSC 28/24: Quotations, 1939

KSC 28/7: Mill Data, 1939

KSC 37/29-36: Blueprints of Power Plant Equipment, 1927-1939

The Kauai Historical Society also holds records relating to Kekaha Sugar Company. The following provided useful information:

Kekaha Sugar Company Annual Reports dating from 1950-1969.

In addition some company records were found abandoned in file cabinets in the mill office building. These materials included:

Boiling House Equipment, March 25, 1958.

Description of Cane Cleaning Plant, April 1969

CF & I Engineers, “External Entrainment Separator,” 1970.

New Molasses Tank, December 1972

Evaporator, Pan and Heater Tubes, January 9, 1986

Juice Heaters, July 1988

1989 Mill Rolls, January 12, 1989

Manual of Nick Phillips, February 1989

Equipment Number List, no date.

Letters

> November 20, 1930, American Factors to Kekaha Sugar Company concerning the proposed chimney, dated 11/20/1930
>
> July 3, 1931, Kekaha Sugar Company to American Factors concerning the new Oliver-Campbell Filter.
>
> August 30, 1946, P.S. Pell & Co. to American Factors concerning long tube evaporators.
>
> October 24, 1947, American Factors to Goslin-Birmingham Mfg. Co. concerning long tube evaporators.
>
> August 18, 1955, McAlister to L.A. Faye, concerning excess bagasse.
>
> March 10, 1966, R.W. Soelberg, concerning fire safety, new bagasse storage building.
>
> April 18, 1973, CF & I Engineers, concerning new juice heater.
>
> August 26, 1985, Kekaha Sugar Co., concerning Factory Automation Project.
>
> March 18, 1997, Nick Phillips, Equipment Requirement for Uprating Kekaha Factory

<u>Bibliography</u>

Aykroyd, W. R., *The Story of Sugar*, Chicago: Quadrangle Books, 1967

Barnhart, George H. W., *Raw Sugar Factory Equipment: A Study of Sugar Yields, Steam Economy and Capacities*, Masters Thesis, University of Hawaii, 1923.

Damon, Ethel, *Koamalu*, Honolulu: Privately Printed, 1931.

Deerr, Noel, *Sugar and the Sugar Cane, An Elementary Treatise on the Agriculture of the Sugar Cane and on the Manufacture of Cane Sugar*, Altringham, Massachusetts: Norman Rodger, 1905.

Deerr, Noel, *Cane Sugar, A Textbook on the Agriculture of Sugar Cane*, Altringham, Massachusetts: Norman Rodger, 1911, 2nd edition, 1921.

Dorrance, William, *Sugar Islands, The 165-Year Story of Sugar in Hawai`i*, Honolulu: Mutual Publishing, 2000.

Experiment Station, HSPA, Department of Sugar Technology

"Special Release 11, 1948 Synopsis of Mill Data,"

"Special Release 96, 1953 Factory Report"

"Special Release, 146, 1955 Factory Equipment"

"Special Release 154, 1956 Factory Report"

"Special Release, 188, 1958 Factory Equipment"

"Special Report, Factory Series, No. 1, 1960 Factory Report,"

Geerligs, Hendrick Coenraad Prinsen, *Cane Sugar and Its Manufacture*, Altringham, Massachusetts: Norman Rodger, 1924.

Gilmore, A. B., *The Hawaii Sugar Manual*

"Recent Development in Factory Practice and Equipment," 1931, pages 45-53.

"Factory and Plantation Data Section, Kekaha Sugar Company, Ltd." 1931, pages .

"Factory and Plantation Data Section, Kekaha Sugar Company, Ltd." 1936, pages 159-163.

Mott-Smith, S., "Combustion of Bagasse and Factory Steam Balance," 1939, pages 40-41.

Bromley, George, "Crystallization in Vacuum Pans and Crystallizers," 1939, pages 41-42.

"Factory and Plantation Data Section, Kekaha Sugar Company, Ltd." 1939, pages 147-152.

"Factory and Plantation Data Section, Kekaha Sugar Company, Ltd." 1947-48, pages 198-203.

"Factory and Plantation Data Section, Kekaha Sugar Company, Ltd." 1951, pages 93-.

"Kekaha's Modern Crushing Plant," 1954, page 15.

"Factory and Plantation Data Section, Kekaha Sugar Company, Ltd." 1954, pages 77-

"Factory and Plantation Data Section, Kekaha Sugar Company, Ltd." 1957, pages 78-.

"Factory and Plantation Data Section, Kekaha Sugar Company, Ltd." 1966, pages 67-.

Hawaiian Sugar Planters' Association, *Story of Sugar in Hawaii*, Honolulu: Hawaiian Sugar Planters' Association, 1926.

Hawaiian Sugar Planters' Association, *Sugar in Hawaii*, Honolulu: Hawaiian Sugar Planters' Association, 1949.

*Honolulu Star Bulletin*

Sommer, Anthony, "Final Harvest for Sugar Fields," November 16, 2000, page A-1.

"Two Kauai Sugar Mills Sold to Investors," April 15, 2005, page C-1.

Jenkins, G.H. and E.R. Behne, *Crystallization of Raw Sugar in Factory Practice*, Brisbane, Australia: S.N., 1941.

McAlister, C. H., "Long Tube Evaporators," A presentation made for the Hawaii Sugar Planters Association in 1950.

Meade, George Peterkin, and James T. Chen, *Cane Sugar Handbook*, New York: John Wiley, 1977.

Melendy, H. Brett, *Hawaii, America's Sugar Territory, 1898-1959*, Lampeter, Ceredigion, Wales: The Edwin Mellon Press, 1999.

Mintz, Sidney, *Sweetness and Power, The Place of Sugar in Modern History*, New York: Viking Press, 1985.

Sanborn Map Company,1919, *Sugar Mill and Cannery Map, Territory of Hawaii.* Kekaha Sugar Company in University of Hawaii, Hamilton Library, Digital Collection.

Soboleski, Hank, *History Makers of Kauai*, Second Edition, Printed in Hawaii, 2006 (these stories were originally published from Sept 2000 to May 2002 in Kauai's *Garden Island* newspaper as a series.

Soboleski, Hank, *History Makers of Kauai*, Volume Two, Printed in Hawaii, 2004 (first edition originally published in Kauai's *Garden Island* newspaper as a series of same title.

Spencer, Guilford Lawson, and George Peterkin Meade, *Sugar Cane Handbook*, New York: John Wiley & Sons, 1945, (first edition 1889).

United States Patent Office, Patent Number 1,059,312, Patented April 15, 1913, James Ogg, Sugar Cane Unloader.

Vandercook, John, *King Cane, The Story of Sugar in Hawaii*, Honolulu: Hawaiian Sugar Planters' Association, 1940.

Wilcox, Carol, *Sugar Water, Hawaii's Plantation Ditches*, Honolulu: University of Hawaii Press, 1998.

Williams, John N.S., *Recent Practice in the Design, Construction, and Operation of Raw Cane Sugar Factories in the Hawaiian Islands*, London: Institution of Mechanical Engineers, 1903.

## PROJECT INFORMATION

The following documentation was prepared in response to the proposal to demolish the historic property and build housing on the twenty one plus acre parcel. The purpose of this documentation is to historically record the architectural and mechanical elements of the mill and its supporting structures. The Hawaii State Historic Preservation Division (SHPD) and the property owner have agreed that the mill complex is over fifty years old, and in a July 15, 2008 letter SHPD indicated that the office believed the mill complex met the criteria for inclusion in the National Register of Historic Places. SHPD recommended that HABS documentation be completed as a means of mitigating the loss of this historic property. The owner agreed to the SHPD's request for documentation, and after further discussion between Mason Architects and SHPD concerning the presence of intact machinery in the mill, it was decided the documentation would follow Historic American Engineering Record (HAER) standards.

The project manager for the HAER documentation was Polly Cosson Tice of Mason Architects, Inc. Don J. Hibbard, Ph.D. and Wendy Wichman of Mason Architects were the researchers and authors of the reports. Both Polly Cosson Tice and Don Hibbard are architectural historians who meet the Secretary of the Interior's Professional Qualifications in architectural history. Carol Stimson of Mason Architects assisted with the editing and production of the reports. The large-format photographs were taken by David Franzen of Franzen Photography.

Figure 1: Location map.

U.S.G.S. Map, Kekaha, Hawaii, 1983